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Methodology and data requirements for reporting on the Landing Obligation (STECF-16-13)

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This report was reviewed by the STECF during its 52th plenary meeting held from 4th to 8th July 2016 in Brussels

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Abstract

Commission Decision of 25 February 2016 setting up a Scientific, Technical and Economic Committee for Fisheries, C(2016) 1084, OJ C 74, 26.2.2016, p. 4–10. The Commission may consult the group on any matter relating to marine and fisheries biology, fishing gear technology, fisheries economics, fisheries governance, ecosystem effects of fisheries, aquaculture or similar disciplines. This report deals with methodology and data requirements for reporting on the Landing Obligation.

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Methodology and data requirements for reporting the Landing Obligation (STECF-16-13)

THIS REPORT WAS REVIEWED DURING THE PLENARY MEETING HELD IN Brussels, 4-8 July 2016

Request to the STECF

STECF is requested to review the report of the STECF Expert Working Group meeting, evaluate the findings and make any appropriate comments and recommendations.

STECF observations

STECF observes that EWG16-04 did their outmost to address all of the ToRs in two parts. In the first part, the seven elements contained in Article 15(14) were discussed and the basis of a template for gathering information according to the Regulation is produced. In the second part, a series of additional metrics to provide a broader approach to evaluating the landing obligation (and the impacts of it) were suggested, including the possible tools and data sources for carrying out such analysis.

STECF observes that EWG 16-04 benefitted from the 2015 submissions from Member States and Advisory Councils since they provided some insights into the operation of the landing obligation. However, these submissions were generally lacking in structure and quantitative information making it difficult to undertake any substantive evaluation.

STECF notes that the EWG has developed a more structured template for the submission of Member States, Advisory Councils and other organisations.

STECF observes that many of the management measures affecting the landing obligation are being discussed, agreed and applied at Member States Regional Groups (rather than at individual Member State level). Furthermore, some of the compliance initiatives seeking to develop the operational approach to implementing the landing obligation are also being developed regionally and in close cooperation with European Fisheries Control Agency (EFCA). While Member States information on progress towards the landing obligation is clearly valuable, so too is information collated at the Regional Group level.

EWG 16-04 also discussed other metrics that might improve the monitoring of the landing obligation. STECF notes that the requirements of Article 15(14) focuses on certain aspects of the landing obligation and its potential impacts mostly ashore at port level. There is a lack of emphasis relating to the monitoring of effects and impacts of the landing obligation in terms of what happens at sea and in the environment. In particular impacts on catch and catch profiles, compliance, selectivity, spatial and temporal changes in fishing operations, longer term socio-economic and environmental effects are not covered.

STECF observes that EWG 16-04 provided a tabular summary of some of those additional metrics considered offering most potential, but this was not possible to do for all the additional metrics due to time constraints. If the objective of monitoring and reporting on progress towards implementing the landing obligation is to provide a holistic

overview capable of addressing questions on all aspects of the policy, then information of this type is very important and collection, collation and presentation of it should be carried out.

STECF notes that some of the additional metrics, such as selectivity parameters of novel fishing gears and results from localised spatial avoidance schemes, will require Member States to submit new information. On the other hand, many of the proposed additional metrics rely on data which arise from ongoing data submission programmes and will not require the burden of new data collection. The strong linkage to data collected through the Data Collection Framework (DCF) and to databases underpinning the Annual Economic Report (AER), Fisheries-Dependent Information (FDI) and other such programmes implies an ongoing requirement to ensure these databases are supported and maintained. Of equal importance is a sound understanding of the reliability and quality of these data. Clearly, the value of the information is drastically reduced if it does not represent the actual situation occurring at sea.

STECF notes that although a number of metrics were identified and discussed rather few of them were thought to be uniquely influenced by the landing obligation – more time is required to examine the scope for isolating and measuring the effects of the landing obligation in metrics potentially influenced by other factors.

STECF notes that the additional metrics might imply inputs from a rather broader range of stakeholders. For instance, Member States compliance operations data together with information by the European Fisheries Control Agency (EFCA) potentially provides important information on the performance of the landing obligation. In this context, STECF notes that much can be learned to improve the quality and relevance of monitoring reporting and evaluation from collaboration between science and compliance community.

STECF conclusions

STECF concludes that the template developed by the EWG, while fairly simple in format and restricted to key questions, represents a positive step in the direction of improving submissions from Member States and others to meet the requirements of Article 15(14). The nature of the questions and the fairly open approach provides a basis for gathering quantitative and semi-quantitative information and as such offers an improvement on the approach used in 2015.

STECF concludes that feedback on the progress within regional areas is critical to understanding how effective the implementation of landing obligation has been and what adjustments in approach might be necessary. Thus, if possible, it would be helpful to have submissions from the Member States groups as well as individually from Member States.

STECF concludes that since the additional metrics are not formally itemised in the current Regulation, some discussion with Member States and others will be required to ensure this information is collected in the future.

STECF furthermore concludes that although some important new metrics have been identified by EWG 16-04, the list should not be seen as exhaustive and Member States or other bodies may have access to information which they feel better helps to illustrate progress towards the landing obligation implementation or impacts of implementation, and should be encouraged to supply it.

Despite the good progress made by EWG 16-04, STECF concludes that further work is required to investigate and refine the list of candidate metrics, including scoping the possibility for isolating and measuring the effects of the landing obligation when the metrics are potentially influenced by other factors.

STECF concludes that because the additional metrics might imply inputs from a rather broader range of stakeholders, compared to the narrow focus of the regulation in requiring submissions only from Member States, Advisory Councils (AC) and Producer Organisations (PO), it might be helpful to consider how to engage these groups, and wider society, in the process of implementing and reporting on the landing obligation.

STECF recommendations

STECF recommends that the Commission encourages submissions from Member States groups, as well as from individual Member States, regarding the effectiveness of the implementation of the landing obligation.

STECF recommends that the Commission encourages all possible actors (MSs, EFCA), regional bodies, industry, science, NGOs, etc.) to work to ensure that catches are effectively monitored and that any shortfalls are adequately documented and clearly understood. This is particularly important for monitoring-at-sea programmes where all information associated with these programmes also requires to be collected (for example, observer refusal rates, coverage, cross checks with other sources of information such as CCTV etc.).

STECF recommends that the Commission facilitates further investigation of the list of candidate metrics, including identification of the metrics with the greatest potential to illustrate progress towards the implementation of the landing obligation.

REPORT TO THE STECF

EXPERT WORKING GROUP ON Methodology and data requirements for reporting on the Landing Obligation (EWG-16-04)

Brussels, Belgium, 2-6 May 2016

This report does not necessarily reflect the view of the STECF and the European Commission and in no way anticipates the Commission's future policy in this area

EWG-16-04 - EXECUTIVE SUMMARY

Methodology and data requirements for reporting on the Landing Obligation (STECF-16-04)

EWG 16-04 met in Brussels from 2 to 6 May 2016. The group comprised STECF members, invited experts, JRC staff, observers from industry and NGOs. DG MARE provided input and feedback during the meeting. The group was provided with 4 TORs collectively addressing two main elements:

1. Identifying the types of information, metrics and indicators that would be useful in reporting on the elements defined in the legislation (Omnibus Article 9 additions as applied to Article 15 of the CFP).
2. Identifying additional information and data that would also be useful to allow evaluation of the impacts of the landing obligation.

Part of the Article 15 landing obligation legislation includes a requirement for member states to report on progress towards implementing the landing obligation and includes 7 elements covering various aspects of the process ranging from member state efforts to ensure compliance with the legislation to socioeconomic effects. The first reports from members states were required for the year 2015. Rather limited submissions were received from member states reflecting the short period of time since the introduction of the legislation, the limited number of species and fisheries affected at this early stage and to some extent, uncertainty about what was expected in the reports. EWG 16-04 considered these early reports in its work towards providing a more coherent semi-quantitative approach.

The working group developed a relatively simple template tp provide a basis for future submissions in line with the Article 15 legislation. The template was divided into 7 sections covering the various reporting elements and for each a series of simple yes/no questions were posed in order to guide the content of submitted material. Some supplementary questions were also added to enable underlying background information to be provided. The template provided by the EWG provides a straightforward, semi-quantitative approach for systematically gathering MS information on the 7 reporting elements.

The EWG emphasised the fact that the reporting elements defined in the legislation do not allow adequate evaluation of what is actually happening at sea as a consequence of the landing obligation and do not provide sufficient information on the impacts of this legislation on fishing practise, fishing operations, the environment or wider socioeconomic effects. The EWG spent some time identifying a number of additional indicators and metrics which could overcome this shortfall and improve the evaluation process of the landing obligation. The topics discussed by the EWG included indicators and metrics from, stock assessments, basic catch profiling, selectivity, changes in spatial activity, socioeconomics and environmental metrics. In each case attempts were made to identify the pros and cons of different approaches and to highlight the most promising examples. It was clear from the discussions that more time was required to refine the list and to explore the different options and this part of the group's work should be considered as a work in progress.

1 INTRODUCTION

Regulation (EU) No 2015/812 (the so-called Omnibus Regulation), introduced an obligation for the Commission to report on the implementation of the landing obligation. The Commission has to submit its first report to the European Parliament and the Council before 31 May 2016, covering implementation in 2015.

According to Article 9 of the Omnibus Regulation, which introduces a new paragraph 14 to Article 15 of Regulation (EU) No 1380/2013 of the CFP, this report should include the following elements:

- steps taken by Member States and producer organisations to comply with the landing obligation;
- steps taken by Member States regarding control of compliance with the landing obligation;
- information on the socioeconomic impact of the landing obligation;
- information on the effect of the landing obligation on safety on board fishing vessels;
- information on the use and outlets of catches below the minimum conservation reference size of a species subject to the landing obligation;
- information on port infrastructures and of vessels' fitting with regard to the landing obligation; for each fishery concerned; and
- information on the difficulties encountered in the implementation of the landing obligation and recommendations to address them.

Article 9 of the Omnibus Regulation clarifies that the report shall be based on information by, among others, the Member States and the Advisory Councils concerned.

The elements listed in Article 15(14) to be reported are focused on the actions taken by Member States and the industry to comply with the landing obligation as well as the practical handling and uses for catches below mcrs once such catches are landed. There is no doubting that reporting under these elements will supply a useful insight into progress with implementation, particularly at port level but will provide little information on what is happening at sea. To measure the effectiveness of the landing obligation at fishery level will require a more detailed analysis of other elements such as catch profiles to measure and track whether any improvement in selectivity has resulted and the types of actions, gear modifications and tactical changes fishermen have taken to comply with the landing obligation. In this regard the Commission has requested STECF to assist by:

3. Identifying the types of information, metrics and indicators that would be useful in reporting on the elements defined in the legislation; and
4. Identifying additional information and data that would also be useful to allow evaluation of the impacts of the landing obligation.

EWG 16-04 has reviewed these two elements and provided a range of indicators, metrics and types of information to address the Commission’s request.

2 TERMS OF REFERENCE

Based on the reporting requirements defined in legislation and other areas where monitoring on a regular basis would be useful. STECF is requested to:

1. Assist the Commission to identify the work needed to develop a set of tools and instruments (including identification and adjustments of data sets and other sources) for future assessment and monitoring of the implementation of the landing obligation (in general and in light of Art 15 CFP).
2. Consider additional information and data that would be useful to allow evaluation of the impacts of the landing obligation and identify possible sources of this information and data for future reporting.
3. Outline a format (structure, content, data, etc.) for future reports by MS that would support more in depth analysis and understanding of the impacts of the landing obligation.
4. Identify possible metrics that could be specifically used to measure the impacts of the landing obligation particularly in terms of catch profiles and socio-economic impacts. Identify data needs to develop these metrics.

To address these ToRs, EWG 16-04 has split them into two parts. The first reports on the seven elements defined in Article 15(14) and the second deals with additional elements, information and metrics that could be supplied to support monitoring of the landing obligation.

Under the first part, EWG 16-04 has identified the data requirements, types of information that could be supplied and possible metrics and indicators under Article 15(14). This deals with ToRs 1 and 4 and is presented in Section 5. EWG 16-04 has also provided a draft template around these elements to address ToR 3. For the second part the EWG has identified a number of additional elements mainly relating to ToRs 2 and 4, these are presented in Section 6.

3 GENERAL CONSIDERATIONS

3.1 Change Management

In implementing the landing obligation most of the focus to date has been on the need for the catching sector to adapt and change how they operate their businesses. Undoubtedly they will be the most impacted by the landing obligation as it will require a complete shift in the mind-set of fishermen. However, upstream and downstream businesses such as fishermen's co-ops, processors and ancillary businesses will be similarly impacted and will have to undergo changes in the way they operate.

The governance that fisheries operate under also needs consideration both nationally and in the wider context at regional and European level. In this regard, fishermen's representatives, stakeholder organisations such as the ACs as well as the management authorities, control agents and scientific agencies will need to consider the policy direction to be taken to implement the landing obligation and their respective roles.

The wider civil society also has an interest in how the landing obligation is implemented given the introduction of the landing obligation was largely driven by public pressure. If it is not possible to demonstrate that the landing obligation is being implemented then, this may impact on how seafood caught in European waters is perceived and make it increasingly difficult to sell seafood. To this end a number of the bigger retailers increasingly moved to sourcing seafood products from only proven sustainable sources. If the Landing Obligation is poorly implemented, the negative public image this would generate could impact on the whole seafood supply chain (Rozarieux, 2015).

The reporting required under Article 15, supplemented by the additional elements identified, provide a means to track progress made by these different actors in implementing the landing obligation in both the short and longer-term perspective. Over time the annual reporting will help to build a picture of how successful the policy has been to affect change and the impacts it has had on the different stakeholders. It will also help inform the wider civil society of whether the policy has worked.

3.2 Member States and Advisory Groups

The focus of many elements in Article 15(14) is on reporting by the individual Member States to be able to track progress towards implementing the landing obligation. However, there is also potential value in being able to evaluate and track overall progress in implementation in each of the Regional Areas described in the CFP through the Regional groups of Member States. Many of the operational decisions and proposals for derogations are decided by these Regional Groups and summaries of progress by region would provide valuable feedback for the ongoing implementation of the landing obligation. EWG 16-04 suggests that information from the Member State Regional groups in addition to that provided individual Member State level would enhance the utility of the reporting. .

It is also important to acknowledge that the Advisory Councils and industry organisations might, for some of the elements, be better placed than Member States to report. In particular these organisations should be able to provide information on practical difficulties encountered by fishermen in implementing the landing obligation as well as documenting evidence of selectivity and avoidance measures taken to avoid unwanted catches. This will be important in monitoring the success of the landing obligation in achieving behavioural change amongst fishermen and is an area where the Advisory

Councils and fishermen's representative organisations can make an important contribution.

3.3 Process and Data Sources

In the course of discussions, EWG 16-04 identified metrics which are most appropriately provided by individual Member States-in line with the general principle of the Regulation (EU) 1380/2013). Some of these relate to the process of implementing the landing obligation (for example, efforts to communicate guidance to stakeholders) and some relate to outputs arising during the course of implementation (e.g. information on economic impacts of the landing obligation).

EWG 16-04 has also identified indicators and metrics which potentially provide better guidance on what is going on at sea (e.g. changes in fishing practice and changes in catch profiles) which might be expected under the landing obligation and also the longer term impacts to the environment. Some of these additional metrics could be provided by Member States to illustrate the results of their particular contributions to implementation. On the other hand, there are a number of the indicators and metrics for which underpinning data requirements are most appropriately obtained from ongoing processes of data submission and collation. It would be unreasonable and inefficient to expect Member States to duplicate these analyses. Many of these larger scale metrics can be derived from international fisheries databases or reports held either in the Joint Research Centre (JRC) or ICES (for example AER, FDI, regional fish databases, DATRAS, MEDITS and stock assessment outputs). These sources of information are populated with data routinely provided by Member States in line with formal data calls and much of the data is collected under the Data Collection Framework (DCF). Furthermore, some of these metrics, applying at the sea basin or fish stock level, can only be generated after a process of data collation has taken place. Requirements for Member States to individually attempt to provide these would be disproportionate and the evaluation of such material, lacking an overall coherence, would be technically difficult and potentially confusing. An essential requirement in the use of these data is that they are of good quality and are indeed representative of what is happening at sea. Failure to achieve adequate observations at sea and failure to ensure that catches of all fish are fully recorded would mean that the international databases could not be used effectively.

EWG 16-04 therefore emphasises that to provide a meaningful evaluation of the implementation of the LO, a *combination* of information from different data sources is required. Ahead of such an evaluation, MS would provide some of its input directly to the Commission according to Article 15(14) of Regulation (EU) 1380/2013 with most of the remainder provided via ongoing processes of data submission. In the case of a Member State's specific information on some of the additional metric proposals, it would be up to the Member State to furnish that to demonstrate progress. In this way there would be no duplication of effort. In order to extract, process and then combine the various data streams in an overall evaluation, EWG 16-04 considers that some form of working group (or ad hoc contracts) of STECF would be appropriate. This can be visualised in Figure 3.1:

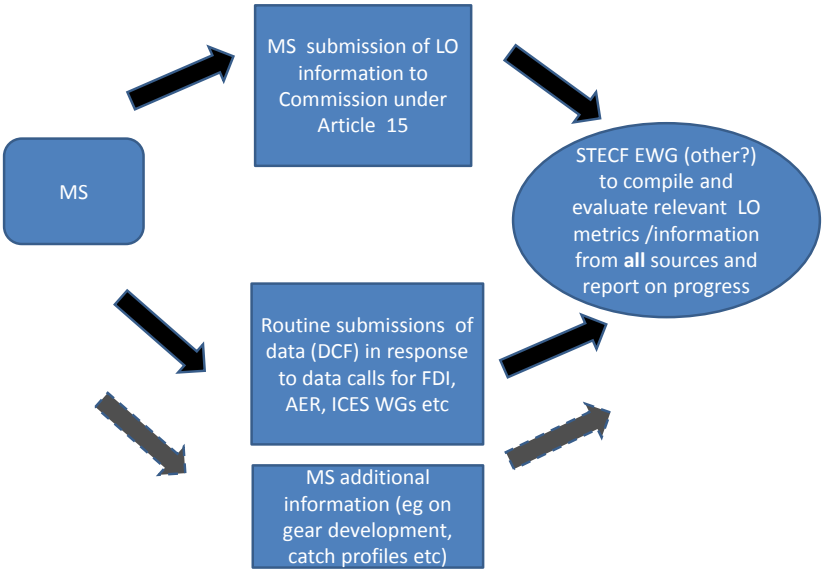


Figure 3.1: Process of delivery of reporting on the landing obligation

EWG 16-04 considered the frequency at which a working group would be required to assess such datasets. To some extent this would depend on the purpose for which the evaluation was required and the types of metric under consideration. The establishment of a series of automated processes would help to ensure that regular updates could be provided to fulfil the Commission's responsibilities to report on progress to the European Parliament and Council of Ministers. In the case of some of the metrics discussed (e.g. those reflecting longer term environmental impacts), annual evaluations would not be expected to provide meaningful results and so a reduced frequency could be proposed for evaluating and presenting these. EWG 16-04 notes that in some areas the monitoring process and supply of relevant data is likely to be more challenging, In particular, features of the fisheries and supporting structures in the Mediterranean militate against standardised procedures. The high proportion of small vessels in the fleets (under the size requiring logbooks) and the multi-gear, multi species operations complicate the documentation of catches – particularly those below mcrs. The hundreds of small harbours/markets further complicates the process and limits coordinated handling, disposal and documentation of unwanted landed catch. Small vessel size also potentially limits the use of current REM and CCTV systems for monitoring. García-Rivera et al. (2015) investigated the effectiveness of the landings obligation in a Spanish Mediterranean port, ultimately concluding that the landing obligation regulation has more weaknesses and threats (72.6%) than strengths and opportunities (27.4%). They argue that the measure may prove to be ineffective in the Mediterranean Sea resulting in a failure to reduce discards. Monitoring the outcomes of the LO will pose a significant challenge in this area.

3.4 The importance of metrics which address process, short term impacts and long term impacts

In considering the existing and additional indicators and metrics for monitoring and reporting, it is clear that these provide insights and reflect different stages in the implementation of the policy. The upper part of Figure 3.2 illustrates the basic timeline from left to right. Following agreement of the CFP including the landing obligation, managers and stakeholders began a series of processes in preparation for the introduction of the first phase of species under the landing obligation. Some of these processes were accompanied by provision of resources (for example, under the European Fisheries Fund (EFF) in the first instance and, then under the European Maritime and

Fisheries Fund (EMFF)). Following implementation, observations and experiences begin to build up from anything or anybody affected by the policy. Initial, short term effects are followed by more substantive medium term outcomes and ultimately by a series of long term impacts – these may or may not indicate achievement of the goals of the policy and may also highlight unintended consequences.

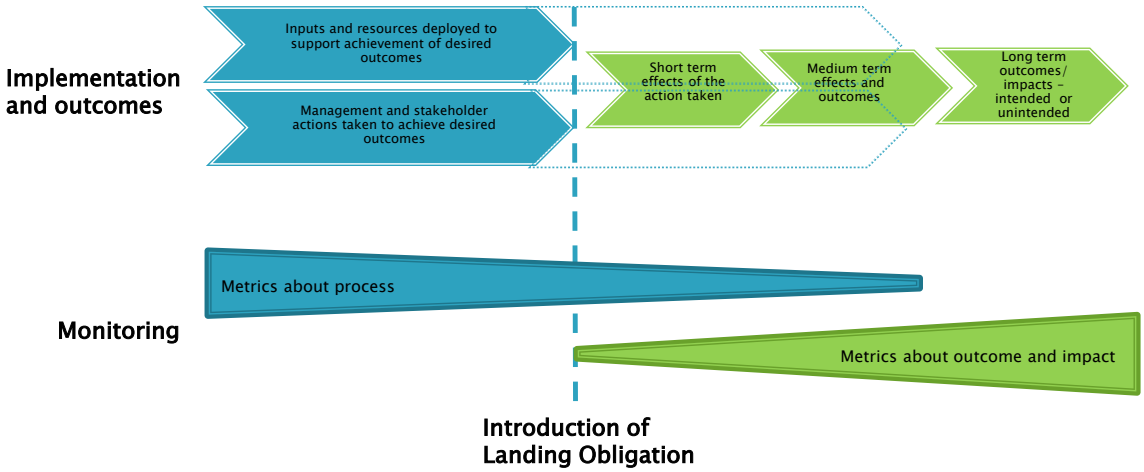


Figure 3.2 Diagrammatic timeline for the introduction of the landing obligation

The lower part of Figure 3.2 shows how the emphasis on the different indicators and metrics in the toolbox will most likely change as the policy is implemented. To begin with, metrics conveying the processes being put in place are the most relevant but over time these, arguably, become less important and are increasingly replaced by metrics reflecting outcomes and impacts. Understandably, over time, the questions become more related to 'has the policy worked and what is its impact' and less about 'what activities can be demonstrated'.

In developing a coherent set of tools for monitoring and reporting the Landing Obligation it is helpful to consider these in the context of the overall implementation timeline to ensure that all aspects are covered appropriately. This will also help to ensure that critical reporting information is available in a timely and efficient fashion.

4 SUMMARY OF 2015 MEMBER STATE REPORTS

The following summary provides an overview of the types of information provided by Member States, Advisory Councils and other industry representative bodies in their submissions for 2015. Most provided short summaries which attempted to address the 7 criteria listed in Article 15(14) but with limited substantive detail and few conclusions. Reports were received from 17 Member States, 4 ACs and from 2 industry representative bodies.

- *Steps taken by MS/PO to comply* - Reports variously listed meetings with industry, publication of leaflets, guidance notes to industry and enforcement authorities and the establishment of web discussion forums etc. In addition, some reports contained information on legislative adjustments, changes to quota management systems and new requirements for Electronic Reporting Systems (ERS). Some contributions reported joint training sessions with EFCA and active participation in the Regional Management Groups and ACs. Several reports gave details of ongoing gear studies to improve selectivity through net innovations and avoidance of unwanted catches and details of the use of EMFF funding to improve infra-structure for dealing with <mcrs catches.

- *Control and Compliance* - Commentary on control and compliance included: the problems created by late adoption of the Omnibus Regulation (Regulation (EU) 2015/812) and conflicts between different Regulations making control problematic; the use of an educational approach to control and compliance at Member State level; approaches involving learning by doing; European fisheries Control Agency (EFCA) regional training programmes (handling the documentation of discards); MS collaborations in Joint Deployment Plans (JDPs) (identifying risk, establishing a level playing field); use of last haul analysis (see section 6.3) and summaries of Remote Electronic Monitoring (REM) and Closed-circuit television (CCTV) trials. Overall there were few reports of infringements but there was 1 successional prosecution for high-grading. A number of initiatives were highlighted in the contributions including: reinforcement of controls in port and at sea; targeted inspection of vessels affected by the landing obligation in some areas; installation of General Packet Radio Service (GPRS) or Vessel Monitoring Systems (VMS) on a wide range of vessel sizes in some areas; haul by haul data reporting in one fishery; and recommendations from two Regional groups for REM/CCTV use in certain pelagic fisheries.

- *Socio economic impacts* - Most of the reports indicated that it was too early to comment on socioeconomic impacts and offered only preliminary observations which tended to reflect potential issues rather than direct observations. The responses on impacts varied according to sea basin /fishery. Costs associated with the handling and transportation of unwanted catch was highlighted and in particular the problem of potential catch sales being lower than the operational costs. The issues of disproportionate cost for leasing quota and for providing separate storage of catches below MCRS were also raised. Concern was expressed that financial losses could reduce the scope and incentives for vessel operators to improve gear selectivity..

- *Safety on-board fishing vessels* - Safety issues did not attract much comment although there were general concerns about increased workload associated with catch sorting and reduced rest times for crew. Some comments were received about the possibility for destabilisation of vessels (e.g. arising from the separate storage of catch <mcrs, and, on vessels which freeze the catch, multiple blocks of frozen material).

- *Outlets for catches below mcrs* - The reports exposed various interpretations of what constituted non-direct human consumption. There were few reports detailing new outlets for below mcrs catches. Usage of these catches was

influenced by the presentation and quality of such catches, the features of local markets (e.g. collection systems, transport logistics etc) and the availability of specialised firms/processing facilities. A key question raised in some reports related to the logic of developing new markets for products which are supposed to disappear over time. This has the potential to discourage research and innovation.

- *Port/vessel infrastructure* - The reports noted the EMFF funding released in June 2015 is likely to be used for port and vessel infrastructure to reduce the cost associated with implementing the landing obligation. Multiple projects are foreseen in Member States Operational Programmes but few examples were given of concrete actions other than the provision of fish handling and waste management initiatives relating to pelagic fisheries.
- *Difficulties encountered* - In general reports on pelagic fisheries suggested that impacts had so far not been significant. For small scale fisheries there were a few issues associated with cost and the handling of unwanted catches and there was a view that larger vessels using towed gears could adapt easier to the landing obligation. In some cases the development of regional discard plans had alleviated some of the problems. Monitoring, control and surveillance (MCS) was seen as the biggest challenge for authorities and REM and CCTV were identified as potentially the most efficient control tools. Electronic Recording Systems (ERS) are not currently well adapted to the requirement for recording discards. The timeframe for survivability exemptions studies is seen as too long and the availability of quota swapping opportunities seen as too late to meet demand.

Some general conclusions can be drawn from the reports. Most notably there are varying levels of understanding of the landing obligation and the general approach appears to involve 'learning by doing'. At this stage Member States found little of substance to report. So far there do not appear to be significant adverse impacts for pelagic operations and it is early days in the case of the demersal fisheries which are preparing for further rounds of implementation. In 2015, legal uncertainties and an unclear regulatory framework did not help the process. So far, many of the reports are characterised by qualitative information and narrative that does not lend itself to systematic evaluation of the progress in implementing the landing obligation. Increased emphasis on the provision of quantitative information would improve the prospects for informed and meaningful evaluation.

5 FUTURE REPORTING UNDER ARTICLE 15.14

The following sections provided guidance on reporting on the elements of Article 15(14), indicating the types of information that could be recorded; the sources of that information; and who is best placed to record and report it. The section addresses, in particular, TORs 1 and 4 and elaborates on the kind of information that would be useful.

5.1 Steps taken by Member States and producer organisations to comply with the landing obligation

This element constitutes a description of steps taken by Member States and Producer Organisations (and other industry sources) under the following broad headings:

- Technical measures
- Quota management and choke species analysis
- Use of exemptions and flexibilities
- Consultation, communication and awareness-raising measures

The Member States and industry reports for 2015 report on most of these elements without providing much detail. The information supplied is a mixture of anecdotal information with some concrete examples of steps or measures taken.

It is not necessary or possible to define specific indicators or metrics for this element given it is largely descriptive. However, in order to help structure responses under this element for future years, the questions below are suggested to help Member States and Producer Organisations (and Advisory Councils) provide information on the steps taken.

The main questions are Yes/No, with some qualifying questions to help provide further details where relevant. It would also be useful to indicate (for each section) whether any of the measures have involved research or pilot projects and been supported by funding under the European Fisheries Fund (EFF) or European Maritime and Fisheries Fund (EMFF). All of this information is readily available and does not constitute collection of anything new. Member States may wish to coordinate answering some or all of these questions with other members of their regional groups. Where this approach is taken it should be indicated which Member States the answers relate to.

Technical measures

Have you initiated, supported, participated in or implemented any measures and/or studies relating to the avoidance of unwanted catches through spatial or temporal changes to fishing behaviour (for example, studies/pilots on real time closures)? Yes/No

a. Please specify the measures taken or studies.

b. Which fleet segments/fisheries do these measures and/or studies apply to?

c. What has the uptake of these measures and/or studies been in the fleet segments/fisheries to which they are applicable? Please provide the number and proportion of vessels in the segment/fishery.

Have you initiated, supported, participated in or implemented any measures and/or studies to change gear selectivity in order to reduce or eliminate unwanted catches of certain species or sizes? Yes/No

a. Please specify the measures taken.

b. Which fleet segments/fisheries do these measures apply to?

c. What has the uptake been of these measures in the fleet segments/fisheries to which they are applicable? Please provide the number and proportion of vessels in the segment/fishery.

Have you initiated, supported, promoted, or implemented any other technical measures to reduce or eliminate unwanted catches? Yes/No

a. Please specify the measures taken.

b. Which fleet segments/fisheries do these studies/pilots apply to?

c. What has the uptake been of these measures in the fleet segments/fisheries to which they are applicable? Please provide the number and proportion of vessels in the segment/fishery.

Quota management and choke analysis

Have you initiated any changes to your quota management system to implement the landing obligation? Yes/No

Please specify these changes.

For stocks managed through catch limits, have you conducted a quantitative analysis to identify potential national choke issues? Yes/No

Please give details.

Have you taken steps to try to mitigate potential choke issues through quota management measures (e.g. creating a national quota pool, inter-Member State quota swaps, swaps between producer organisations, etc.)? Yes/No

a. Please specify these measures.

b. Which fleet segments/fisheries do these measures apply to?

c. How effective have these measures been in allowing fleet segments/fisheries to take advantage of all their fishing opportunities?

Use of exemptions and flexibilities

Have you pursued any exemptions to the landing obligation (either for high survival or de minimis) in the development of regional joint recommendations? Yes/No

a. Please give details of each exemption pursued.

b. What studies or evidence have you collected or produced in order to support such a request.

c. What steps have you taken to ensure the amount discarded under granted de minimis exemptions does not exceed the permitted volume in the delegated act?

d. What has been the utilisation of any granted de minimis exemptions in the fleet segment/fishery to which the exemption applies? Please provide the total weight and proportion of catch discarded under this exemption for each fleet segment/fishery to which an exemption applies.

Have any of your vessels utilised the provision to discard fish which shows damage caused by predators? Yes/No

a. Please provide the total weight of catch of each species discarded for each fleet segment/fishery concerned.

For stocks managed by catch limits, did you make use of the provisions for inter-annual or inter-species flexibility? Yes/No

a. Please identify which flexibility (or flexibilities) was used, and the corresponding reallocation of fishing opportunities for the stocks concerned.

Communication and awareness-raising measures

In the development of joint recommendations, has consultation with Advisory Councils and other relevant stakeholders taken place? Yes/No

a. Please outline the process of consultation with Advisory Councils.

b. Please outline the process of consultation with other stakeholders, if relevant.

Following the adoption of the delegated act for a discard plan, have steps been taken to ensure adequate understanding among stakeholders of their obligations under the provisions of the act? Yes/No

a. Please outline the process of ensuring stakeholders understand the obligations that will apply to them.

Other measures

Are there any other steps not covered by the questions above that you have carried out to effect compliance with the provisions of the landing obligation? Yes/No

a. Please specify the measures taken.

b. Which fleet segments/fisheries do these studies/pilots apply to?

c. What has the uptake been of these measures in the fleet segments/fisheries to which they are applicable? Please provide the number and proportion of vessels in the segment/fishery.

5.2 Steps taken by Member States regarding control of compliance with the landing obligation

This reporting element deals with control and monitoring measures taken by Member States to implement the landing obligation. For this element and with the purpose of harmonising the information and making it comprehensive, EWG 16-04 considers that it would be beneficial, in addition to the Member States contribution, for Member States regional groups to present regionally implemented actions. This information should emanate from control authorities and the expert control groups set up by the Member States regional groups. Information from the Advisory Groups on difficulties with compliance would be better reported on reporting element 7 detailed in section 5.7.

The following elements regarding control of the landing obligation are provided in the report. In case the answer to the question is yes, supporting information should be provided as described in the bullet points. This list is not definitive. Where appropriate, supporting quantitative data should be provided.

Has information been provided by Member States administrations and control agencies to fishermen? Yes/no

What format has this information taken:

- Initiatives directed to fishermen to improve compliance

- Guidelines on the application of the landing obligation, accurate recording of catches, etc.
- Other

Have guidelines been provided by Member States administrations and control agencies for inspectors? Yes/no

What format has this information taken:

- Delivery of guidelines for inspectors on the effective and uniform application of the landing obligation.
- Seminars and trainings organised for presenting the guidelines to inspectors at national and regional level.

Have new control and monitoring tools been used by Member States? Yes/no

Please supply information on:

- Control tools used in the context of landing obligation, i.e. REM, traditional systems (aerial surveillance, inspections at sea), reference fleets, etc.
- Steps towards implementation of new tools, including electronic monitoring means dedicated to implementation of landing obligation, haul-by-haul recording, etc.

Have the Member state administrations and control authorities monitored below Minimum Conservation Reference Size (MCRS) catches at and after landing (traceability)? Yes/No

Please supply information on:

- initiatives taken to prevent under MCRS catches from reaching the commercial channels (pre-notification of landings of under MCRS catches, etc.).
- Measures taken to monitor landings at fish markets/auctions adopted.

Has control and monitoring been based on risk assessment? Yes/no

Please supply information on the risk assessment tools used and the results obtained, including those implemented by the regional Control Expert Groups in cooperation with EFCA.

Has the "last observed haul" approach elaborated by EFCA as a tool for monitoring the implementation of the landing obligation and to derive potential targets for inspection been used. Yes/No

Please give details of the fisheries covered and the extent of sampling.

Have the results of the "last observed haul" approach or other data collected during compliance activities been compared with other available historical data sets (e.g. STECF/ICES) Yes/No

5.3 Information on the socioeconomic impact of the landing obligation

Reporting under this element could potentially incorporate a wide range of information and quantitative data. The important questions about the social and economic impacts of the implementation of the landing obligation relate to:

- impacts on survival and performance of businesses (will vessel businesses fail or flourish? Will processing businesses suffer decrease in required raw material or benefit from an abundance of previously unavailable raw material?)
- impacts on jobs (number of jobs in fleet and directly related businesses, wages, changes in workload and working conditions); and
- impacts on social aspects (shifts in type of employment available, unemployment in affected communities, criminalisation of previously required activities).

There are a multitude of metrics and indicators that potentially help to quantify these impacts and for this reason a much more detailed analysis of these possible indicators and metrics that could be measured is provided in Section 6.6. It is important to note that the socio-economic impacts will relate not only to the catching sector but also upstream businesses, processors, consumers and also Member States.

Most of these metrics and indicators can be generated from information already collected under the economic data reporting element of the DCF so there is not necessarily additional data collection required. Table 5.1 summarises the main types of indicators/metrics that could be reported and would provide indications of the socio-economic impacts of the landing obligation. These are split into operational, financial, economic and social impacts depending on the different sectors or stakeholders.

Metrics and measurements for impacts on the catching sector

Operational	Financial	Economic	Social

• **Fuel use ratios**
  ○ **per tonne landed***
  ○ per day at sea*
• Total days at sea per segment
• **Tonnes landed per day at sea***
• **Average trip duration**
• **Vessel use indicator***
• **Number of choke situations**
  ○ **Vessel level**
  ○ **PO level**
  ○ **MS level**
  ○ **EU level**
• **Ratio of anticipated chokes / observed choke situations**
• **Quota uptake***
• **Ratio of landings for human/non-human consumption**
	• **Sales prices per size grade of fish**
	• **Foregone Revenue due to change in size profile of landings**
	• Disposal costs for unsold fish
	• **Number of business failures attributed to choke situations**
	• **Total number of business failures**
	• **Value of fishing rights***
	• **Fish prices pre and post fleet level choke**
	• Total landings income*
	• Labour costs*
	• Fuel costs*
	  ○ Total*
	  ○ Additional due to LO
	• Repair costs*
	• **Estimated value of uncaught fish**
		• **Number of Vessels***
		• **Number of inactive vessels***
		• **Number of enterprises***
		• **Inactive fleet indicator***
		• Investments*
		• GVA*
		• **Operating (Gross) Profit***
		  ○ total per segment
		  ○ average per vessel
		• Fishing rights values
		• Fishing rights ownership/allocation
		• Use of EMFF for vessel or gear adjustments to comply with the LO
			• **Number of FTEs***
			• **Wages/Crew share***
			• **Average wages per FTE**
			• Working Hours*
			• Number and proportion of non-EEA crew
			• Incidence of non-compliant business practice.
			• Incidence of observer harassment
			• Weight of landings per crew member, by fleet segment.

Metrics and measurements for impacts on upstream businesses

Operational and Financial	Economic	Social
• **Value of sales by gear manufacturers** • **Number of improved selectivity fishing nets sold** • Value of sales of on-board technology • Value of sales by boat builders to fishing businesses • **Number of business failures, start-ups or expansions**	• Number of highly fishing dependent enterprises	• FTEs • Wages • Number of high-technology jobs

Metrics and measurements for impacts on processing businesses reliant on landings by vessels subject to the Landing Obligation

Operational	Financial	Economic	Social
• Volume of imported raw material to replace LO-caused foregone supplies • Volume of sales • Volume of raw material purchased for non-human consumption • **Business failures and start ups due to lack of raw material or availability of new raw material**	• **Value of purchased fish and raw material for production *** • **Turnover*** • **Total production costs*** • **Value of sales for non-human consumption**	• **Number of enterprises*** • GVA* • Strategic alliances eg. Processors engaging in gear selectivity trials or purchase of fishing rights • Net investments*	• **FTEs*** • **Wages***

Metrics and measurements for impacts on consumption & markets

• Consumption of different product sizes of fish in retail and foodservice • Consumption of imported fish in retail and foodservice • Incorporation of LO-related issues in environmental certification schemes • Consumption of new products based on fish by-products • Sales of non-human consumption products • Sales of bait • Public attitudes towards discarding and the LO

Costs to Member States for the implementation of the Landing Obligation

• Staff Costs • Additional Control Costs • Expanded Observer/REM Programmes • Legal Costs • Funding sources and amounts • Use EMFF funding to cover additional administration costs

Table 5.1 Summary of the metrics and information that could potentially be used to show the impacts of the Landing Obligation on the different industry sectors. *indicates information is already collected and presented in the fleet or processing sector Annual

Economic Reports or in the STECF balance report. **Bold type** indicates the metrics identified by EWG 16-04 as potentially the most useful.

5.4 Information on the effect of the landing obligation on safety on board fishing vessels

This reporting element can be separated into reports of incidents on board fishing vessels and specific observations documenting practical problems on board fishing vessels that impinge on the health and safety of the crew. These primarily relate to overloading of vessels (i.e. stability issues) or safety issues arising from excessive workload on board (i.e. breaches of Health and Safety legislation).

The Member State and industry reports for 2015 do not report any major safety issues on board vessels other than providing some anecdotal information that highlight potential problems. Future reporting on this element will almost certainly remain largely "anecdotal", emanating primarily from reports by the fishing industry. There may also be occasional incidents reported by Coastguards, Health Ministries, Labour Inspectorates, Control authorities or by industry. Some Member States may use funding under the EMFF to mitigate the risks.

In most cases, attributing such information or incidents directly to the landing obligation will be difficult although where there is evidence that compliance with the landing obligation was a contributing factor, then, these should be documented. Overtime it may be possible to build up a record of the number and nature of work-related injuries and accidents that can be fully or partially attributed to the landing obligation. The Advisory Councils, Producer Organisations and Trade Unions along with national authorities such as the national Marine Casualty Investigation Boards are best placed to collate such information.

In order to structure responses under this element for future years, the questions below are suggested to help Member States and the catching sector provide information on incidents, actions taken and funding in relation to safety issues.

Have there been any reported incidents of overloading of vessels causing stability problems? Yes/No

Please specify the number and nature of such incidents.

Can you quantify these in terms of:

Number of deaths or serious injuries

No of vessels involved as a % of the specific fleet segment

Have there been any reported incidents of overloading of vessels forcing operators to return to port early? Yes/No

Please specify the number and nature of such incidents.

Have there been any reported incidents or accidents on board vessels that can be attributable to excessive workload? Yes/No

Please specify the number and nature of such incidents or accidents.

Has any national legislation relating to safety on board fishing vessels arising from the landing obligation been amended or introduced? Yes/No

Please provide details of this legislation.

Have you provided or received any funding under Article 32 (Health and safety) of EMFF or Article 3 (Eligible operations on safety) and Article 6 (Eligible operations on working conditions) of Commission Delegated Regulation (EU) 2015/531 to mitigate against potential safety issues caused by the landing obligation? Yes/No

If yes, please specify the number of projects involved and the nature of the measures taken.

If no, have any measures been taken which have not been funded under the EMFF

5.5 Information on the use and outlets of catches below the minimum conservation reference size of a species subject to the landing obligation

This reporting element can be split into:

- Information on the different uses of catches below minimum conservation reference sizes;
- Information on the outlets for such catches.

The Member States and industry reports for 2015 provide little quantitative information on this element and their reports tend to focus on potential difficulties of disposing of such catches given the perceived lack of available markets for fish below mcrs. The lack of concrete information supplied is also a reflection of the fact that the fisheries currently under the landing obligation are essentially "low discard" fisheries with relatively small volumes of fish below mcrs. When demersal fisheries are brought under the landing obligation in the years up to 2019 then these volumes are likely to increase significantly.

Future reporting on this element is likely to be a mixture of qualitative information on the uses and destinations for catches below mcrs and quantitative information relating:

- to the volume of these catches;
- price per tonne generated; and
- costs associated for the handling and transportation of such catches to the different outlets.

The Producer Organisations and first point of sale organisation such as Fishermen's Co-operatives as well as sales notes information from the national control authorities are likely to be the best sources of information for this element.

Additionally it would be useful for Member States and Advisory Council to report on any studies or pilot projects carried out to look at the potential uses and outlets for catches below mcrs.

In order to structure responses under this element for future years, the questions below are suggested to help provide information on catches below mcrs.

What have been the main reported uses and destinations for catches below mcrs?

Can you quantify these catches by species in terms of volumes, price per tonne and associated costs for the different outlets such catches have been sent?

Have you carried out any studies or pilot projects considering the potential uses for such catches? Yes/No

Please provide details of such studies or pilot projects.

5.6 Information on port infrastructures and of vessels' fitting with regard to the landing obligation for each fishery concerned

This reporting element can be split into:

- Adaptations of port facilities (completed or planned) for the handling of unwanted catches and to add value to catches both wanted and unwanted; and

- Modifications to vessels (completed or planned) for the handling of unwanted catches on board and to add value to both wanted and unwanted catches.

The Member States and industry reports for 2015 provide some specific examples of works undertaken in 2015 and indicate there will be considerable investment under the EMFF in future years. On this basis the obvious indicator for capturing such changes in future reports will be the level of investment and the number and nature of projects carried out by Member States under their national EMFF programmes. Reporting on this element can be taken directly from the national reports required under the EMFF.

The following questions are suggested to help Member States and the catching sector to report on this element.

Have you provided funding under Article 38 of the EMFF for modifications on board vessels for the handling of catches on board? Yes/No

Please specify the number, nature and total amount invested in such projects.

*Have you provide funding under Article 43 of the EMFF for investment in the infrastructure of fishing ports, auction halls and shelte*rs for the handling of unwanted catches? Yes/No

Please specify the number, nature and total amount invested in such projects.

Have you provide funding under Articles 68 and 69 of the EMFF for investment in marketing measures and the processing of fishery and aquaculture products? Yes/No

Please specify the number, nature and total amount invested in such projects.

5.7 Information on the difficulties encountered in the implementation of the landing obligation and recommendations to address them

This reporting element constitutes a description of problems and difficulties encountered by Member States and the fishing industry in implementing the landing obligation. The 2015 reports highlight specific problems encountered in 2015 and identify potential problems foreseen for future years. In most cases, however, there is no quantitative evidence provided about the scale or extent of the difficulties, nor was there any discussion of possible solutions. The STECF EWG notes that many of the steps taken by Member States and Producer Organisations to implement the landing obligation identified under the 1st reporting element are likely to offer potential solutions.

To take account of these observations, Member States and Advisory Councils are encouraged to:

- include quantitative information where possible,
- include information on possible solutions to the difficulties encountered,
- consider structuring their feedback under this provision according to the following headings

<u>Operational difficulties, such as:</u>

- Avoidance and/or selectivity insufficient to avoid unwanted catches
- Handling, storage and processing of unwanted catches
- Lack of funding to adapt fishing gears, vessels or port infrastructure

<u>Difficulties relating to monitoring, control and enforcement, such as:</u>

- Lack of understanding or awareness of the rules
- Difficulties implementing and monitoring *de minimis* or high survivability exemptions

- Implementation problems with regard to control/monitoring processes or infrastructure (e.g. adaptation of ERS systems)
- Refusal to carry observers

Difficulties in fully utilising fishing opportunities, such as:

- Problems re-allocating quota to cover catches previously not landed
- Problems with the timing or availability of quota swaps
- Fisheries being forced to close early due to choke problems

6 DEVELOPMENT OF NEW METRICS RELATED TO POTENTIAL EFFECTS OF THE LANDING OBLIGATION NOT PRESENTLY COVERED BY ARTICLE 15(14)

The following sections develop ideas for metrics and indicators that go beyond the elements of Item 15(14). The section addresses, in particular, TORs 2 and 4 and elaborates on the kind of information that would be useful

The requirements for formal monitoring under Article 15 overlook a number of potential elements critical for understanding whether the policy is achieving the aim of reducing discards. The impact and outcomes of the landing obligation on 'at sea' fishing operations and the characteristics of the catch and landings are particularly obvious and crucial elements which require to be monitored. Discussions by EWG 16-04 identified a number of interlinked approaches and data sources that could furnish relevant metrics associated with catch profiles and fishing operations. Principal amongst these were: metrics arising from stock assessments; metrics associated with direct monitoring of catch and landings; metrics associated with various aspects of selectivity occurring in the fisheries.

The approaches are discussed in turn and necessarily include some overlap illustrating the linkages. It is helpful to understand the way they are related since not all species or fishery situations across Europe have access to the same types of data and different regions may need to utilise different data sources and approaches in order to monitor and track the characteristics of catches.

Routinely produced assessment outputs potentially offer 'readymade' material for consideration as metrics. The use of this material is discussed first (6.1) and attention is drawn to some of the difficulties of relying on this material.

Direct observations of catch and landings are another obvious choice and may be provided by individual MSs – here, sources arising principally from scientific monitoring (6.2) and also from compliance (6.3) activities are discussed.

Finally, catch metrics associated with selectivity (gear or fishery) are developed and discussed (6.4). Subsequent sections discuss spatial metrics (6.5), socioeconomic metrics (6.6) and longer term environmental metrics and indicators (6.7).

6.1 Use of stock assessment outputs

Basic methods involving the direct recording of catches split into landings above MCRS, and discards and landings below MCRS (generated by the landing obligation) is a straightforward and obvious way to identify the change in fishing pattern generated by the landing obligation, (see 'Catch Profiles' section below). The separation of catches into three categories is already used for fisheries operating in the ICES areas and catch statistics by area, country and fleet strata can be obtained through the ICES database InterCatch. This approach has the advantage of simplicity but will only work if there is no bias in the catch statistics (i.e. observed catches are representative of what happens at sea). Furthermore, other factors such as recruitment strength may also impact catch profiles and thus limit our ability to measure the effects of the landing obligation. A variety of information sources and cross checks may be required to ascertain whether the basic assumptions are indeed met.

The output from analytical fish stock assessments has some potential to be used for detecting changes and trends in fishing patterns initiated by the introduction of the landing obligations. The idea is to identify changes within the time series, which might arise from changes in fishing pattern or fishing strategy associated with the landing obligation. However, the approach is complicated by the fact that:

- Few fisheries only target a single species or a single stock and few stocks are only fished by a single fishery. Therefore, the identification must in most cases be based on a summary of a number of stock specific analytical assessments, which

altogether might support conclusions leading to the identification of changes in fishing patterns in one or more fisheries.

- Potentially, there are numerous other reasons for observed structural changes in the assessment results and diagnostics other than changes in selectivity or selection pattern alone. These other reasons could be related to changes in year class strengths, changes in spatial distribution of the stock, mixing with other stocks, irregularities in the catch statistics, changes in regulation and changes in market conditions which may or may not be related to the landings obligation. Excluding the effect of these factors from the assessment in order to attribute the possible changes in the assessment results to the introduction of the landing obligation might be challenging as many of them might have more or less the same influence on the assessment output and diagnostics.

There are two particular areas of interest for identifying outcomes related to the introduction of the landing obligation, which may have an impact on the assessment results:

- the first case is to identify any change in fishermen's traditional behavior in connection with the introduction of the landing obligation and
- the other is to identify any potential violation of the landing obligation.

The consequence of a violation of the landing obligation can, in the assessment input data, be compared with the consequence of unallocated landings because one component of the landing in both cases is missing from the statistics. This will manifest itself as increased lack of internal consistency in the catch matrix and changes in age specific catchability reflected in the catch residuals. In all cases, only violations leading to substantial under-reporting of the catches will be detectable considering the variance already existing in the system coming from sampling variance, age readings etc.

In assessments where discards are not integrated, the landing obligation would introduce additional fishing mortality of the age groups formally discarded. Although the major impact on the overall fishing mortality estimates will come from the newly introduced younger age groups, there may also be effects on the exploitation patterns of the older ages. The latter could occur if former discarding was a result of slipping, discarding of choke species, discarding because of fish damage (eg gillnet catches damaged by seals) or of high grading. It will therefore be possible to identify this as a consequence of the introduction of the landing obligation. The step change in landings and its effect on mortality in part of the time series could make it hard to distinguish less obvious effects of the landing obligation on mortality at age.

For assessments where discards are already included, it is necessary to investigate the changes in F by age in order to be able to identify change in fishing pattern related to the landing obligation. Comparison of the F's of age groups below and above mcrs would also be valuable.

Where discards are still permitted (de minimis exemptions and on grounds of high survivability) the changes in fishing pattern related to the landing obligation could be expressed as changes in the proportion of the F generated by discards and F generated by the landings (including contributions from the landing obligation). This is necessarily so because changes in a fishing pattern related to the landing obligation need to be considered in terms of changes in proportions split between landing and discard F rather than in the total F by age group. The split of fishing mortality into F deriving from discards and F deriving from landings is not standard in some assessment software, but is possible in others. Again, only substantial changes in fishing pattern will be detectable due to the variance already existing in the system and possible overshadowing by other changes.

The preliminary conclusion for the moment is that assessment output and diagnostics may not be readily suitable for detecting changes in fishing pattern generated by the introduction of the landing obligation owing to the complexity in the data and the variance connected to the output. However, analysis of different splits of fishing mortalities, which are calculated separately as partial Fs either generated from discard or from landing (not using age or length as the criteria for the split) or if this is not possible, providing F for ages below and above mcrs, may lead to better insights to changes in fishing behavior reflected in the assessment results, and therefore possibly directly attributable to the introduction of the landing obligation when appropriate. Some potential candidate metrics derived from the assessment process are shown in Table 6.1.

Similarly, examination of the quality of an assessment time series may point to some 'disturbance effect' around the time of introduction of the landing obligation. Furthermore, it is likely that the coordinated introduction of the landing obligation will leave some common fingerprints on all the assessments of relevant stocks in a given area, which collectively may be detectable and indicate a change in the fishing pattern.

Table 6.1 Summary of potential stock assessment metrics

Description	Short/long term	Data needed	Pros	Cons
Comparison of F for < MCRS and > MCRS Or consideration of F at age where age is used as a proxy for < MCRS or > MCRS	Medium to long term	All required for an age (or length) specific stock assessment.		Confounded by various factors but especially varying year class strengths.
Comparison of F from sources of still permitted discards (de minimis; high survivability)	Medium to long term	All required for an age (or length) specific stock assessment, including separate data for landings and discards.	Tracks relative significance of mortality from sources of discarding still permitted compared to landings.	Only substantial changes in fishing pattern likely to be detectable. Only some assessment packages able to treat landings and discards separately.

6.2 Use of catch profiles to track progress in implementing the landing obligation

As basic indicators of what is happening at sea in response to the landing obligation, examination of catch profiles and the tracking of any changes in those profiles over time is an obvious choice. The catch profiles could simply consist of quantities of the different components of the catch (e.g. discards, landed <mcrs and landed for human consumption) or could make use of more detailed length or age information.

There are potentially two kinds of use for these data providing different types of indicator and metric:

- Short term: In this case, catch profile information could be used to provide a cross check to see if there is a discrepancy between what is observed at sea and what is recorded on the markets (i.e. between what is caught and what is landed). The use of this tool is perhaps more closely linked to compliance activities.
- Longer term: Catch profiles could also be tracked over time however, in order to infer how selection pattern might be changing over time. In fisheries previously characterised by discards of very small fish, the use of nets with mesh sizes progressively increasing over time in order to release unwanted fish and meet the requirements of the landing obligation would be expected to exhibit catches with generally reducing proportions of small fish.

Short Term

Short term catch profile analysis could make use of a number of types of data. Where these data include information on commercial grade sizes of fish, length composition and/or age there is scope to monitor the relative catches of small fish and also scope to monitor catches of fish in larger size categories which are sometimes discarded through high grading in the event of insufficient quota. The different types of data include:

a) Compare logbook data to data from the market (e.g. amount < mcrs and amount by commercial categories)

- This could be a check for a group of vessels rather than an individual vessel but,
- Needs to compare for same area, gear and vessel category (e.g. LOA) i.e. must be truly comparable, not a mixture of factors.
- Operates as a consistency check. Not very useful if vessel(s) systematically discard and then make sure their logbook entry and market landing are in close agreement.

b) Compare data from personnel at sea monitoring to data from market (this could make comparison between length compositions or ages)

- Need to compare for same area, gear and vessel category (e.g. Length overall (LOA)
- Need unbiased observer coverage.
- Compromised if vessels change behaviour (which could affect the catch profile) when an observer is on board.
- Could be collected by scientific observers or during 'last observed haul' operations (see Compliance/Control section).

c) Compare CCTV data to data from market

Random sampling of video material from vessels fitted with CCTV/REM, coupled with market sampling of those vessels could provide an indication of whether the landing obligation is being adhered to (see also section on Compliance Control). Furthermore, comparisons of landings of fully observed and compliant CCTV boats operating in an area could be compared with the landings of other boats operating in the same area and with the same characteristics. Both approaches offer a means of assuring the landed catch represents the full catch. Over time, changes in the incidence of non-compliance could be monitored. Important points for consideration here are:

- Need to compare for same area, gear and vessel category (e.g. LOA)
- Technically more demanding (ideally requires tools to process footage eg image analysis)

- Potentially less biased by changed behaviour (if sufficient vessels involved and vessel unaware it is being 'sampled')

Longer Term

a) Monitoring of catch at age/length

There are potentially two ways in which this metric and the underlying data could be used

i) Looking at the overall catch profile for a stock over time reflects both selectivity at gear level and the structure of the fleets exploiting the stock, (i.e. relative proportion of gear types used etc).

ii) Comparison between gear types or fleet sectors enables additional questions to be answered, for example 'is the selectivity of a gear and/or fishing strategy used by some vessels generating different catch profiles and 'improving' faster than other vessels.

Some important points for consideration here are:

- When considering time trends, expert knowledge is needed on stock development (especially on recruitment strength).
- There is an element of subjectivity in the process; the measure gives a qualitative perception of whether one group of vessels has a better catch profile than another or whether the catch profile for some or all vessels is improving over time.
- Figure 6.1 and 6.2 provide examples where vessels engaged in Fully Documented Fishery (FDF) trials from two countries - Scotland and Denmark - were compared to non FDF vessels from the same countries operating in the North Sea. In this case there is little difference in the catch profile since vessel with and without FDF are using similar gears. On the other hand, Figure 6.3 provides a rather extreme example where a difference is demonstrated between Scottish vessels using two very different gears (small meshed TR2 vs larger meshed TR1). (Data obtained from STECF EWG 14-13).

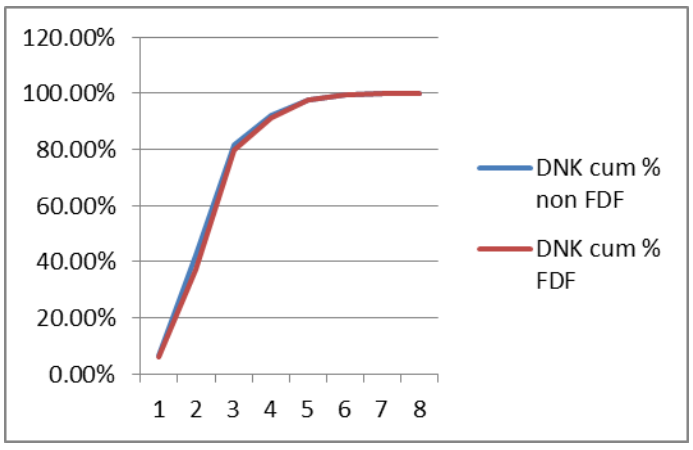


Figure 6.1 Cumulative percentage of catches over ages for Denmark.

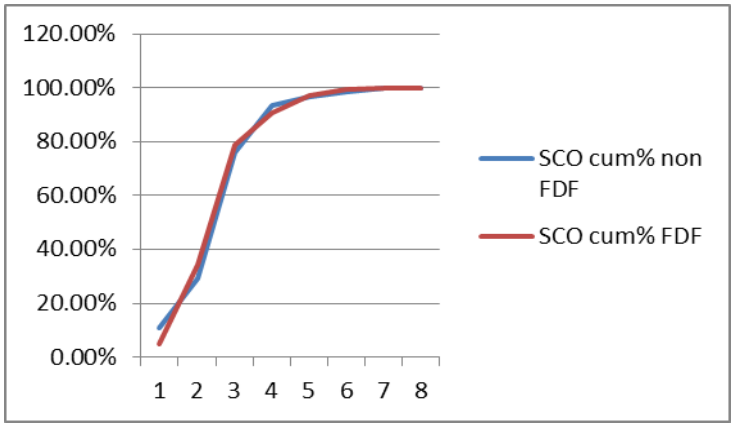


Figure 6.2 Cumulative percentage of catches over ages for Scotland.

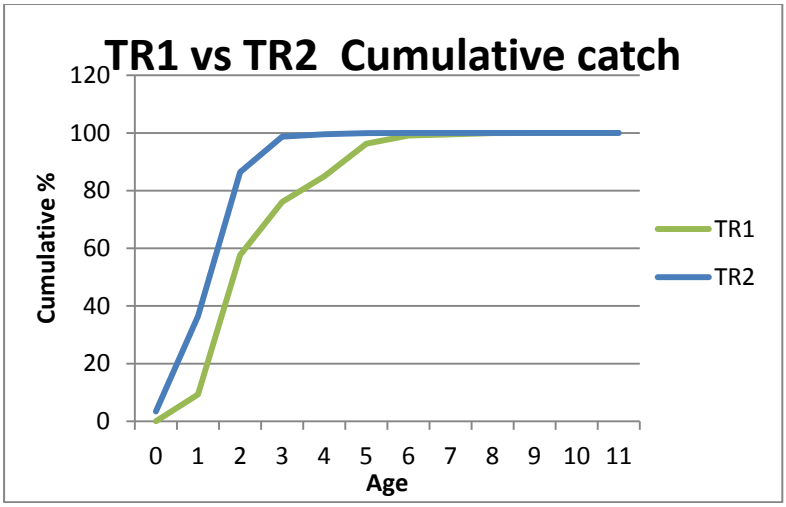


Figure 6.3 Cumulative percentage of catches over ages for Scotland

b) Compare the catch profile from the market to the catch profile from surveys.

Some progress has been made recently in making inferences about commercial catch profiles based on research vessel survey catches and comparing these with landings length compositions to infer discard quantities (Heath and Cook 2015). Comparisons of this kind could be used to determine to what extent discarding was still occurring and therefore whether progress was being made towards successful implementation of the landing obligation.

- This approach either assumes all ages/lengths are selected equally by both the survey and the commercial gear – or requires adjustments to be made to the catches based on known selectivity parameters for the gears in question.
- Compare the proportion of catch caught at age a (Xa) in the survey with proportion of catch caught at age a (Ya) in the commercial landings (i.e. use Ya/Xa) see Figure 6.4. Similar comparisons of lengths at age could be made and this would provide opportunities for many species to be examined which do not currently have available age data.
- A more simple measure is simply to calculate the proportion of the catch in survey/ landings both <mcrs and >mcrs.

Before LO						
Biomass index	100	74.08182	54.88116	40.65697	30.11942	22.31302
Prop at age from survey	0.310508	0.23003	0.170411	0.126243	0.093523	0.069284
catch	30	40	25	15	10	5
Prop at age from catch	0.24	0.32	0.2	0.12	0.08	0.04
Catch/Biomass index	0.3	0.539944	0.45553	0.36894	0.332012	0.224084
Prop catch at age / Prop biomass at age	0.772926	1.391121	1.173635	0.950545	0.855401	0.577335
Some time after LO						
Biomass index	100	74.08182	54.88116	40.65697	30.11942	22.31302
Prop at age from survey	0.310508	0.23003	0.170411	0.126243	0.093523	0.069284
catch	10	20	30	20	12	7
Prop at age from catch	0.10101	0.20202	0.30303	0.20202	0.121212	0.070707
Catch/Biomass index	0.1	0.269972	0.546636	0.491921	0.398414	0.313718
Prop catch at age / Prop biomass at age	0.325305	0.878233	1.778235	1.600245	1.296063	1.020542

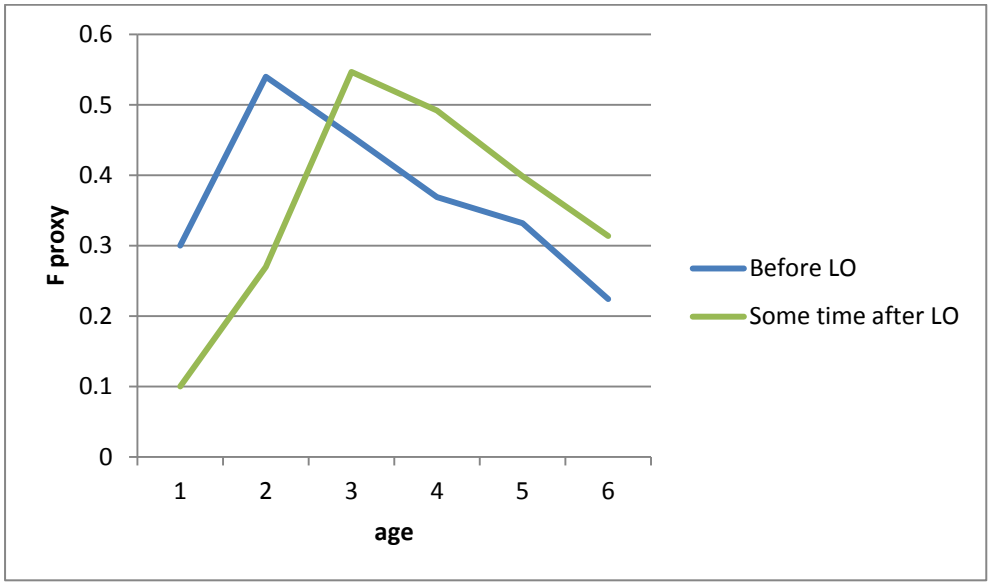


Figure 6. 4 Illustration of the comparison between the catch profile from the market to the catch profile from surveys (made up data)

c) Compare catch profiles from fleet segment to numbers at age/length from a stock assessment

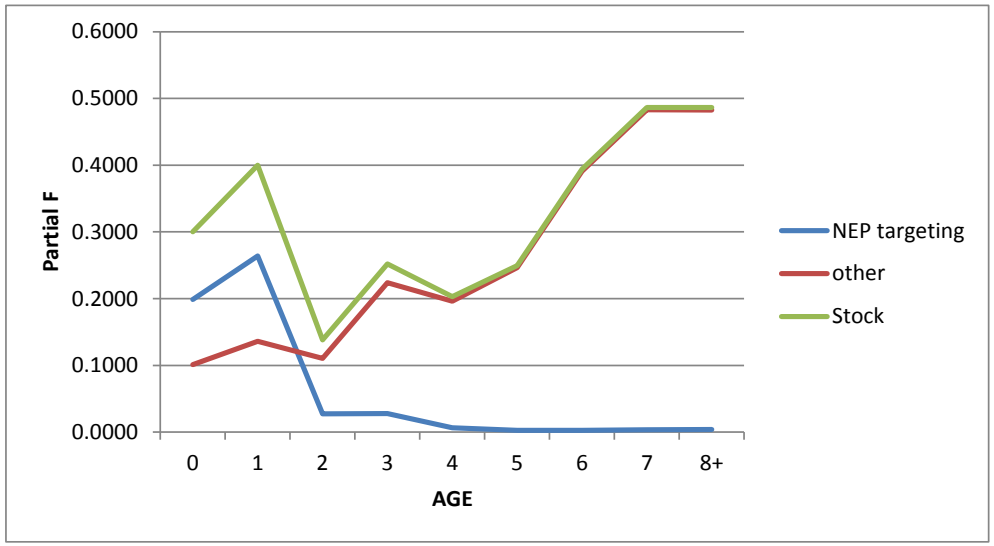
- In this case the process is based on a calculation of partial Fs at age/length for a fleet segment.
- The technique is valid for comparing the relative contributions to F at age between fleet segments in a given year but not to consider the evolution of catch

profiles over time. This is because the overall F at age in stock assessments is largely determined by commercial catch data.

- For a few stocks (e.g. hake) the assessment itself gives fleet specific F at age/length. It is important to ensure the model is not configured to keep fleet selectivity constant over time.
- An illustrative example, Figure 6.5, is given below. In this example two fleets take catches from a stock, a fleet that targets Nephrops and an 'other' fleet. Before the landings obligation catch is composed of landings and discards for each fleet, but with discards of young fish much more significant component of the catch at age for the Nephrops fleet. Post- landing obligation the F at age has decreased overall for the stock at the younger ages but the relative contributions of the Nephrops and other fleet have changed. This in itself does not prove the Nephrops fleet has improved selectivity in response to the landings obligation but indicates it may have done so.

Before LO

Age	Stock Exploitation pattern	Landings other	Landings NEP targeting	Discards other	Discards NEP targeting	Catch other	Catch NEP targeting	LANDINGS NEP targeting Exploitation pattern	LANDINGS other Exploitation pattern	DISCARDS NEP targeting Exploitation pattern	DISCARDS other Exploitation pattern	CATCH NEP targeting Exploitation pattern	CATCH other Exploitation pattern
0	0.3	14.24	0.02	30650.34	60087.39	30664.58	60087.41	0.0000	0.0000	0.1986	0.1013	0.1986	0.1014
1	0.4	1235.8	510.97	9511.54	20336.85	10747.34	20847.82	0.0065	0.0156	0.2575	0.1204	0.2639	0.1361
2	0.1382	9797.09	2334.8	122.59	120.34	9919.68	2455.14	0.0261	0.1094	0.0013	0.0014	0.0274	0.1108
3	0.2519	14372.96	1774.11	8.94	8.77	14381.9	1782.88	0.0276	0.2240	0.0001	0.0001	0.0278	0.2241
4	0.2029	7776.92	262.44	0.1	0.1	7777.02	262.54	0.0066	0.1963	0.0000	0.0000	0.0066	0.1963
5	0.2493	7973.34	84.96	0	0	7973.34	84.96	0.0026	0.2467	0.0000	0.0000	0.0026	0.2467
6	0.3938	6074.79	42.01	0	0	6074.79	42.01	0.0027	0.3911	0.0000	0.0000	0.0027	0.3911
7	0.4865	3958.98	28.6	0	0	3958.98	28.6	0.0035	0.4830	0.0000	0.0000	0.0035	0.4830
8+	0.4865	4013.53	33.96	0	0	4013.53	33.96	0.0041	0.4824	0.0000	0.0000	0.0041	0.4824



Some time after LO

Age	Stock Exploitation pattern	Catch other	Catch NEP targeting	CATCH NEP targeting Exploitation pattern	other Exploitation pattern
0	0.0971	30664.58	30087.41	0.0481	0.0490
1	0.1185	10747.34	9847.82	0.0567	0.0618
2	0.1382	9919.68	2455.14	0.0274	0.1108
3	0.2519	14381.9	1782.88	0.0278	0.2241
4	0.2029	7777.02	262.54	0.0066	0.1963
5	0.2493	7973.34	84.96	0.0026	0.2467
6	0.3938	6074.79	42.01	0.0027	0.3911
7	0.4865	3958.98	28.6	0.0035	0.4830
8+	0.4865	4013.53	33.96	0.0041	0.4824

Note that the assumption in this example is that no discards are allowed post LO.

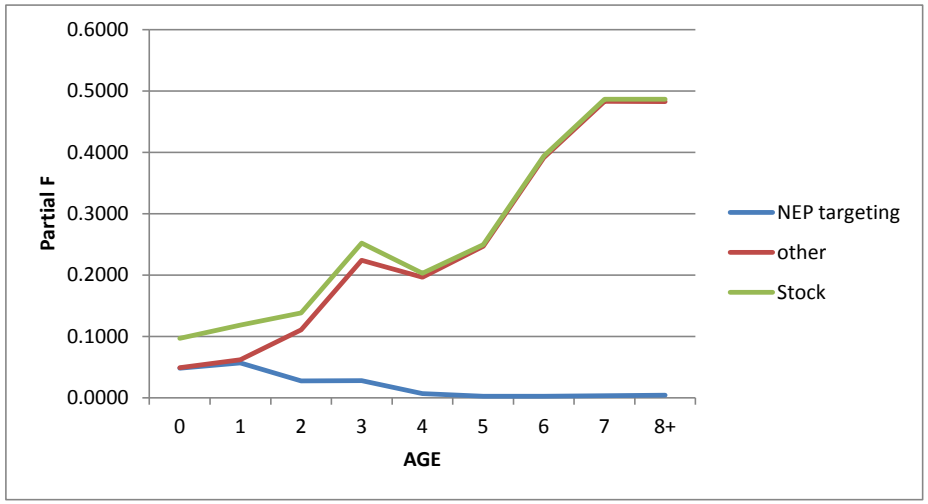


Figure 6.5 Illustration of the comparison between fleet segments, making use of stock assessment F at age data (made up data)

6.3 Compliance control and the work of EFCA

Vessel and port sampling by compliance authorities and the potential collection of other metrics arising from compliance related activities provide another way of monitoring progress towards implementing the landing obligation.

With the aid of the European Fisheries Control Agency (EFCA), regional groups have categorised fleet segments and have conducted a risk assessment exercise to classify them according to risk of non-compliance. This work has been possible through the implementation of the Joint Deployment Plans (JDPs) where EFCA coordinate regional efforts of Member States in collecting catch-composition data by the so called "last observed haul" inspections carried out on-board fishing vessels. In these inspections the catch composition of the last observed haul of the vessel is recorded in terms of weight per species and quantities above or below mcrs for species covered by the JDP. EFCA is also developing with Member States a tool based on the analysis of size classes collected from sales notes which are linked to the corresponding fishing trip. The number of fishing trips where a certain volume of cod (the volume could vary according to segment and area) is landed and having no presence of size class 5 cod is analysed. This system is particularly useful for monitoring high grading.

EFCA has produced tables (discard rate matrixes) by area in which historical data from STECF/DCF, logbook data provided by Member States, and last-observed-haul inspection data collected under the JDP are compared and analysed. Member States have supported EFCA in following-up these comparisons over a number of years of implementation of the JDPs. At this stage it is difficult to ascertain how comparable the data derived from the different sources are. Discussions between relevant parties in some areas (e.g. the Baltic) suggest a reasoanble degree of comparability. For the future, a more extensive review is required involving several more sea areas and bringing together compliance and scientific expertise including those involved in developing the statistical sampling designs underpinning different data sources.

It should be noted that last observed haul inspection data collected in the framework of the JDPs, as all control and inspection data, is subject to the confidentiality of professional and commercial secrecy (article 113 of the Control Regulation (EC) No 1224/2009). According to this article, "*these data shall not be used for any purpose other than that provided for in the Control Regulation unless the authorities providing the data give their express consent for the use of the data for other purposes and on condition that the provisions in force in the Member State of the authority receiving the data do not prohibit such use*". Therefore, the use of these last haul inspection data needs to be agreed with the Member States (JDP Steering Groups). Alternatively, since EFCA is already analysing these data and comparing it with historical (STECF/DCF) and logbook data for risk assessment and for monitoring compliance with the landing obligation, the results of these analyses could be fed into the landing obligation implementation process initiated by EFCA. It needs to be stressed that in any case the last observed haul inspection data is collected by the Member States control and inspection authorities not EFCA.and thus there is a need to discuss any possible initiatives with Member States under the framework of the EFCA JDPs.

Additionally, catch compositions could be observed through Fully Documented Fisheries (FDF), including CCTV. Ongoing developments utilising video measurement and more sophisticated image analysis techniques enable lengths of fish (and therefore weights) to be estimated.

Whether from on board inspections or through remote means such as CCTV, the observed data can then be systematically compared with catch-composition data from the reported landings of vessels of the same fleet segment that have operated in the same area at the same time. Incentives may continue to exist for the discarding of specimens below mcrs, smaller market categories (high-grading), species that threaten to choke the fishery, species of low market value. If such specimens are being discarded owing to non-compliance to the landing obligation, it is expected that these will be found in smaller proportions of the reported landed catch than in the observed catch.

Discrepancy between the observed versus the reported catch composition cannot be used as evidence of discarding in any individual case (because catch compositions can vary by chance or skipper skills), but trends in the magnitude of these discrepancies at aggregate level are being considered by EFCA and the Member States as an indicator to evaluate compliance with the

landing obligation. At the same time, declining trends in the proportions of unwanted specimens (below mcrs or of the choke stock) in the inspected catch could be an indicator of progression in avoidance behaviour. These trends could be interpreted by looking at changes in selective-gear uptake or changes in spatiotemporal effort allocation (see sections on selectivity and spatial analysis in this report).

Other data that are available at the national control agencies are, the infringement rates (in terms of number of infringements per number of inspected trips). Trends in the infringements rates (including non-discard related), could be indicative of trends in compliance culture. An investigation of the possible use of such indicators is, however, still a work in progress and a better understanding of the consistency between Member States is required.

Based on the discussion of various forms of catch profile analysis, Table 6.2 summarises some of key metrics and their pros and cons

Table 6.2 Summary of potential catch profile metrics including from both scientific and compliance sampling

Description	Short/long term	Data needed	Pros	Cons
Comparison of logbook declaration with market data.	short	Logbook data; sells notes at market	Relatively simple to collect	A crude measure. Only relevant for fleets where logbooks required.
Comparison of catch profile (at age or length) between at sea observations and landings.	Short & Longer term	Catch profile from observer trips; numbers at age (or numbers at length) data in landings from the same area, gear and vessel category	Allows both short term check and longer term monitoring	<u>If observers used</u> Behaviour of fisher may change when observer on board. Could be very limited coverage of specific area, gear and vessel category combinations
Specific case of last haul inspection data(on-board compliance)	Short and long term	Catch composition and live weight by species form hauls inspected. Ratio <mcrs />mcrs	Allows both short term check and longer term monitoring Fleet segment comparison; trends over time; indicator of compliance with the LO; Analysis already begun by EFCA	Coverage and species limited by JDP framework. Availability of the data for non-control purposes (article 113 of Reg. 1224/2009)
Monitoring of catch at age/length	long	Numbers at age (or numbers at length) data in landings or at sea observation	Landings data should be available (STECF or ICES). Easy computations. Can compare between gear types or fleet segments.	Expert knowledge needed on stock development (especially recruitment strength)
Ratio of landings at age to survey catch at age (as a proxy for F at age)	long	Research vessel survey; numbers at age (or numbers at length) data in landings.	Landings data should be available (STECF or ICES). Relatively simple computation. Can compare between gear types or fleet segments.	For some stocks the survey may not have a uniform selectivity e.g. hake
Use of stock assessment to derive partial F at age/length	long	Age or length resolved stock assessment. Catch profile by fleet segment.	Landings data should be available (STECF or ICES).	Relatively few stocks have full age/length stock assessment. Assessment F is largely driven by catch data so only meaningful to consider relative contributions to F between fleet sectors

6.4 Selectivity metrics

The LO aims to reduce unwanted catches. A substantial portion of such unwanted catches refers to undersized fish, i.e., fish with a size lower than mcrs. Since the LO is envisaged to gradually reduce fishing pressure on undersized fish, metrics of size selectivity that could be used to assess and monitor the successful implementation of the LO should be able to capture the development of the fishing pressure on undersized fish. EWG 16-04 discussed a number of candidate metrics which apply at either the gear or population level. Some relatively simple gear selectivity metrics are discussed first of all, followed by examples of more novel gear based metrics. The section then explores series of selectivity based metrics relevant at the population level.

Simple gear selectivity metrics

The introduction of the LO should shift the emphasis from prescribing fishing gears that are permissible, to a results-based system where the fishers will be expected to develop gears that will avoid unwanted catches (Alzorriz et al. 2016). A useful metric related to gear selectivity would be a quantification of the uptake of more selective gears from a fleet and/or in a specific geographical area. This could be approached by **the number of new gears/shifts in gear** observed at the fleet level. This metric could be particularly useful in cases where more detailed data on gear selectivity are absent. A related metric, with low data requirements, would be the **mesh size and configuration** in existing gears, so as to monitor gear modifications. A successful implementation of the LO would be expected to increase the number of new/modified gears used by a fleet.

Some standard metrics of gear selectivity that could be used to monitor the success of the LO in achieving behavioural change amongst fishermen, through the uptake of more selective gears, are **length at 50% retention** (**L50**) and **selection range** (**SR**) (Wileman et al. 1996). All these metrics are population-independent and can be expressed as age-based metrics as well. A successful implementation of the LO would be expected to increase L50, as the gear should retain less undersized fish and decrease SR, as a lower SR results to the capture of fewer undersized fish.

Novel gear selectivity metrics

Besides the above mentioned standard metrics, some novel selectivity metrics are available for monitoring the effects of the implementation of the LO at the gear level. These metrics are the mean proportion of individuals below and above the mcrs retained by gears, namely **nP₋** and **nP+** respectively, and the ratio of their numbers (**nRatio**) (Herrmann et al. 2012; Sala et al. 2015). These metrics can be calculated as follows:

$$nP\text{-} = 100 \cdot \frac{\sum_{\ell<MCRS} n_{CD\,\ell}}{\sum_{\ell<MCRS} n_{CD\,\ell} + n_{CV\,\ell}}$$

$$nP+ = 100 \cdot \frac{\sum_{\ell\geq MCRS} n_{CD\,\ell}}{\sum_{\ell\geq MCRS} n_{CD\,\ell} + n_{CV\,\ell}}$$

$$nRatio = \frac{\sum_{\ell<MCRS} n_{CD\,\ell}}{\sum_{\ell\geq MCRS} n_{CD\,\ell}}$$

In practice, a two-compartment binomial data format is required such that for each size class, ℓ a certain number of fish occur in the cover $CV(n_{CV\,\ell})$ and a certain number in the codend $CD(n_{CD\,\ell})$, i.e. a length-dependent retention likelihood. The indicator nP_{-} provides a fast estimate of the fraction of undersize fish retained (< mcrs), thus providing information on the size selectivity of a given gear towards the small fish of a given population. The value of nP_{-} should therefore be

as low as possible, and is expected to become lower in response to a successful implementation of the LO.

Similarly, indicator *nP+* provides information on the efficiency of a given gear in selecting commercial sizes (≥ mcrs) when fishing a given population. In such cases, provided that the species being analysed is a target species, *nP+* should be as high as possible (close to 100).

Indicator *nRatio* is the ratio of the number of retained undersized/commercial size individuals. Therefore, when fishing a given population, the size selection properties of a gear are well aligned to a given mcrs if the *nRatio* is very low, approaching 0. The above indicators are based on specimen number. Indicators based on weight (*wP-*, *wP+, wRatio*) can also be calculated using the same formulae. To do this, the weight w_ℓ of each individual of size ℓ must be estimated according to the general formula $w_\ell = a \cdot \ell^b$.

To provide an indication of the utility of the nRatio approach, two scenarios (Figures 6.6-6.8) are compared as follows:

1st scenario: same selective gear fishing different populations (i.e. different area or time of the year)

This scenario shows the effect of a certain gear when fishing a different population in different areas and/or time of the year. Catch profiles in terms of proportion of fish smaller than mcrs would be different despite of the same selectivity.

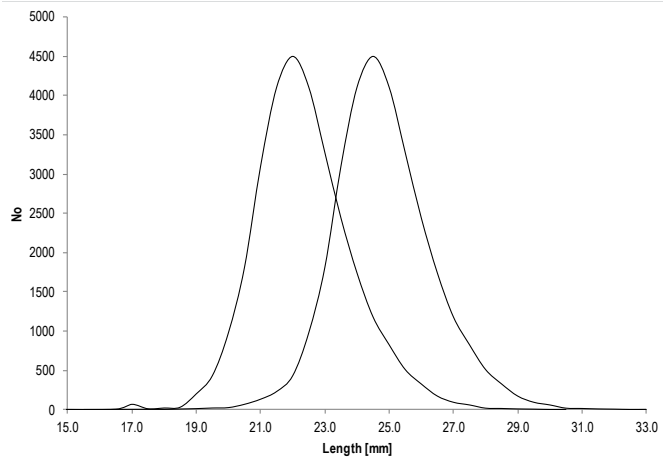


Figure 6.6. Curves represent two hypothetical populations of fish entering the gear.

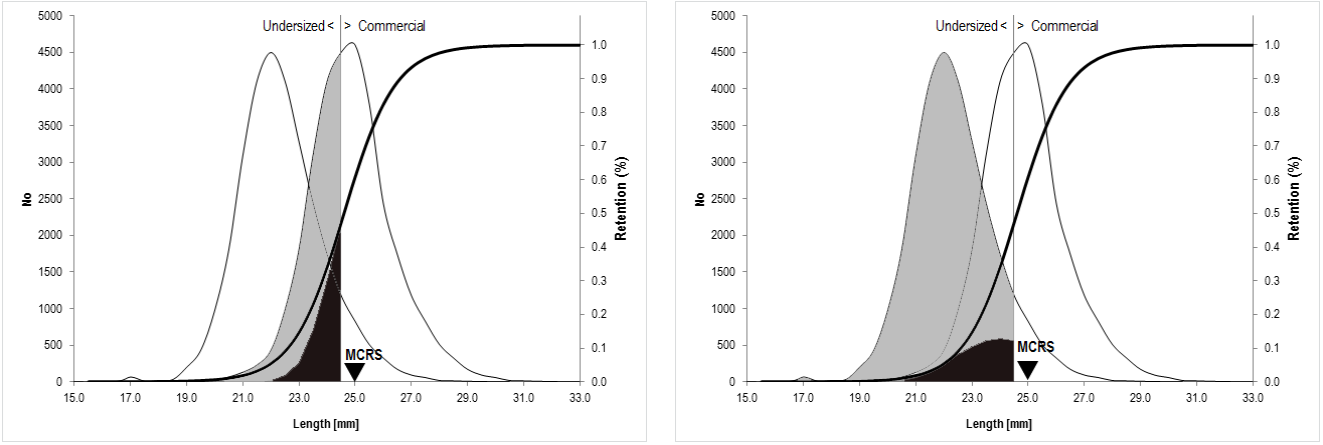


Figure 6.7. Two whole hypothetical populations of fish entering the gear (population of larger fish –left diagram and population of smaller fish-right diagram) ; mean size selectivity curve; hypothetical MCRS; in dark-grey the retained fraction of fish below

MCRS (*nP−*), the sum of the dark- and light-grey area is the whole fraction of fish below MCRS entering the gear.

2nd scenario: different selective gears fishing the same population (i.e. gear changing or the introduction of a technical measure)

The second scenario shows the effect of different gears when fishing the same population. Catch profiles in terms of proportion of fish smaller than MCRS would be different despite the same population.

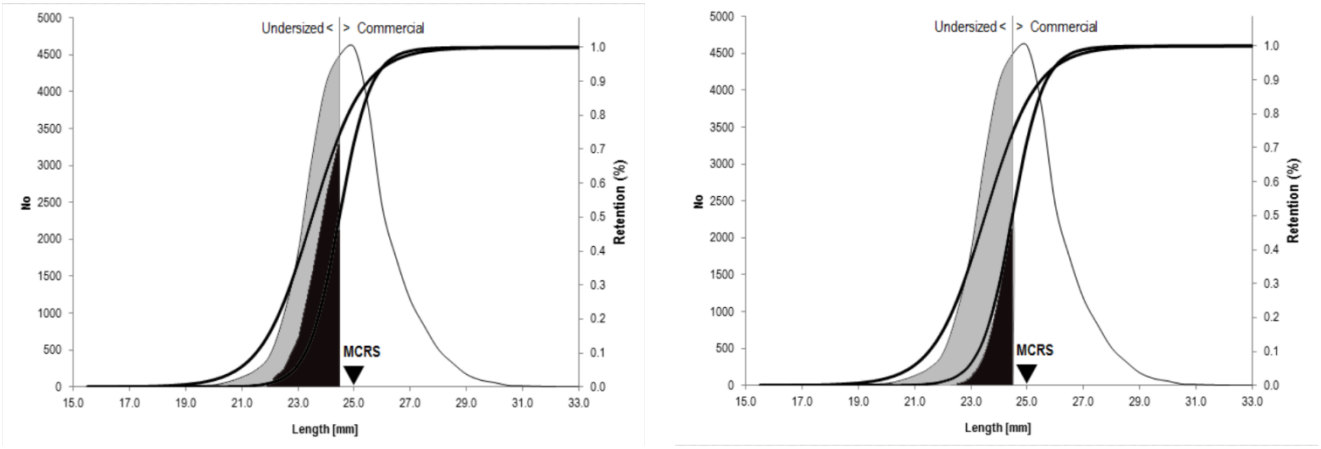


Figure 6.8. Same hypothetical population of fish entering two different gears (gear with improved selectivity on the right); mean size selectivity curve; hypothetical MCRS; in dark-grey the retained fraction of fish below MCRS (*nP*$_-$), the sum of the dark- and light-grey area is the whole fraction of fish below MCRS entering the gear.

From the comparison of scenarios it is possible to make a number of observations. Firstly, measurement of catch profiles in terms of proportion of fish smaller and/or larger than MCRS (see next section below) do not completely allow the monitoring of selectivity improvements in fisheries.

Secondly, prediction of the effect of any technical gear parameter on the indicators ***nP***$_-$, ***nP***$_+$, ***nRatio***, or the equivalent weight-based *wP*$_-$, *wP*$_+$ and *wRatio* can be obtained using the best predictive selectivity model and the total fish population encountered by the gear. It would be worthwhile to clarify that such retained fractions are affected by the size composition of fish population coming into contact with the gear. These indicators can be presented as guidelines, whose application allows identification of the some fishing techniques that provide improved size selectivity.

It is clear that in order to monitor and measure the effectiveness of the landing obligation in terms of improvements in selectivity and behavioural change, then additional actions need to be considered, such as regular monitoring (or sampling under the DCF) to track the size composition of the population, and the average gear selectivity by area.

Metrics at the population level

A simple and straightforward selectivity metric to assess the fishing pressure on undersized fish is the **proportion of fish <mcrs** in the catch by weight in the whole stock (Froese, 2004). A successful implementation of the LO would be expected to reduce that proportion (but see limitations discussed above). The advantage of this metric is that it is easy to calculate and communicate to stakeholders. However, it has the disadvantage of being very sensitive to the population structure, as it correlates to the availability of undersized fish in the sea (Figure 6.9). In other words, in years when high availability of undersized fish leads to the capture of high quantities of these fish, use of this metric could lead to false alarms for the occurrence of

unsustainable fishing practices. A way to address this shortcoming of the metric would be to standardise the proportion of fish <mcrs in the catch by using some recruitment index derived from a survey or a stock assessment. Another way to reduce the effect of recruitment pulses on the selectivity metric would be to use F-based metrics.

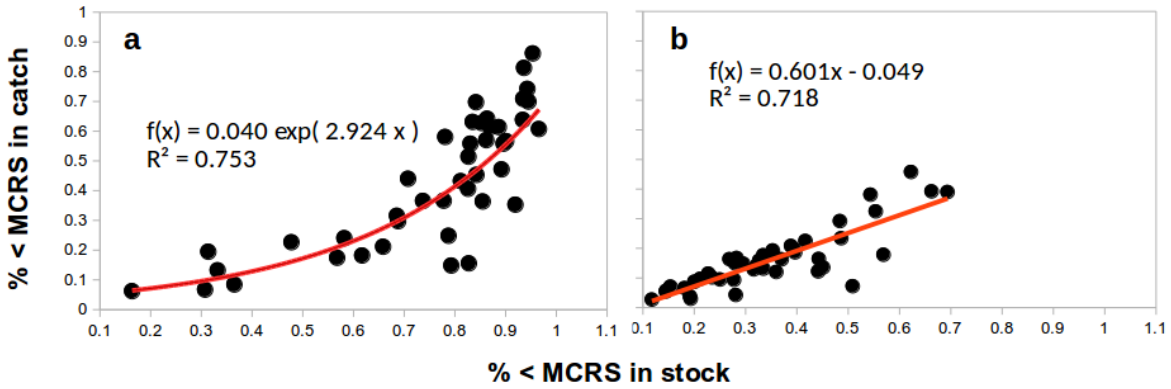


Figure 6.9. Proportion of undersized fish in the catch by weight in relation to the proportion of undersized fish in the population by weight for a stock with high recruitment variability (North Sea haddck) (a), and a stock with reduced recruitment variability (North Sea sole) (b). The metrics were calculated using stock assessment data for 1972-2014 (ICES 2015).

A simple F-based metric could be the **F of the age class(es) <mcrs**. A successful implementation of the LO would be expected to reduce the value of this metric. This metric would be much less sensitive to population structure than the proportion of fish <MCRS in the catch. In stocks with intense recruitment pulses, such as North Sea haddock, there is still some correlation of that metric with the proportion of undersized fish in the population, but that is not the case in stocks with reduced recruitment variability, such as North Sea sole (Figure 6.10).

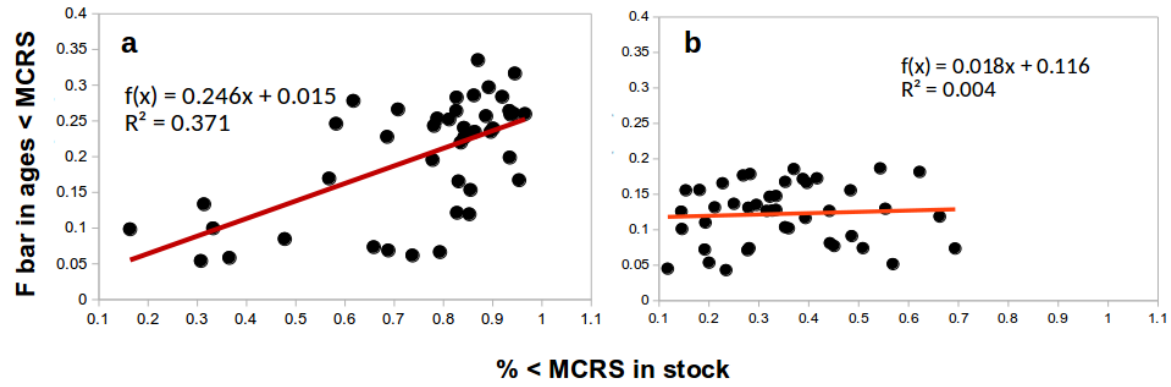


Figure 6.10. Mean F of the age-classes referring to undersized fish in relation to the proportion of undersized fish in the population by weight for a stock with high recruitment variability (North Sea haddock) (a), and a stock with reduced recruitment variability (North Sea sole) (b). The metrics were calculated using stock assessment data for 1972-2014 (ICES 2015).

Another F-based metric that would further reduce the effect of population structure would be the ratio $\mathbf{F_{<MCRS}/F_{>MCRS}}$ weighted by abundance, that would provide an estimate of the relative fishing pressure on individual undersized fish in relation to the equivalent fishing pressure on individual legal size fish (STECF 13-04). $F_{<MCRS}$ is equal to $\Sigma F_{a1}*N_{a1}/\Sigma N_{a1}$ and $F_{>MCRS}$ is equal to $\Sigma F_{a2}*N_{a2}/\Sigma N_{a2}$ where N is abundance, a1 refers to the age-classes <MCRS, and a2 refers to the age classes ≥MCRS. A successful implementation of the LO would be expected to reduce the value of this metric. This metric is independent from population structure, as shown in our analysis for both North Sea haddock (high recruitment variability) and North Sea sole (low

recruitment variability) (Figure 1.11). The effect of a similar metric on stock status has been proved to be negative (Vasilakopoulos et al. 2011).

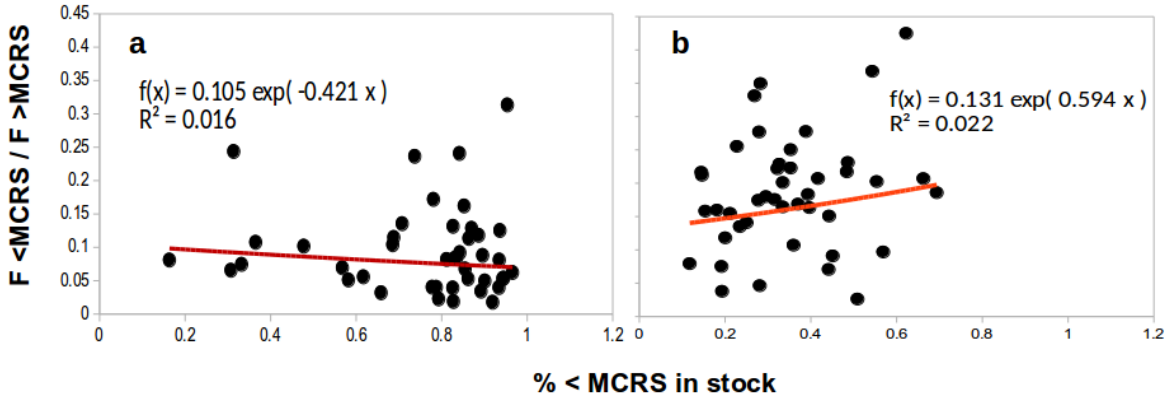


Figure 1.11. F of undersized fish divided by F of commercial fish, weighted by abundance in relation to the proportion of undersized fish in the population by weight for a stock with high recruitment variability (North Sea haddock) (a), and a stock with reduced recruitment variability (North Sea sole) (b). The metrics were calculated using stock assessment data for 1972-2014 (ICES 2015).

A third F-based metric, expressing population selectivity that can be used for monitoring the effects of the LO, is the difference between the age (or length) at 50% selection (A50) with A_{MCRS} (or MCRS), i.e. **A50-A_{MCRS},** or **L50-L_{MCRS}** (STECF 2015-04, Vasilakopoulos et al. 2015). A successful implementation of the LO would be expected to increase the value of this metric. Population selectivity curves can be estimated by scaling assessment-derived F-at-age vectors from 0 to 1 (Sampson and Scott, 2011). In age-based assessments, A_{50} estimates for population selectivity can be derived by fitting sigmoid lines from the first to the fully selected age-class. This difference has been shown to have a substantial effect on both long-term SSB and yield of different species (Vasilakopoulos *et al.*, 2014, 2015). Similarly to the $F_{<MCRS}$ metric, A50 (or L50) are somewhat correlated to population structure in stocks with great recruitment variability, such as North Sea haddock, but are less so in stocks with reduced recruitment variability, such as North Sea sole (Figure 6.12).

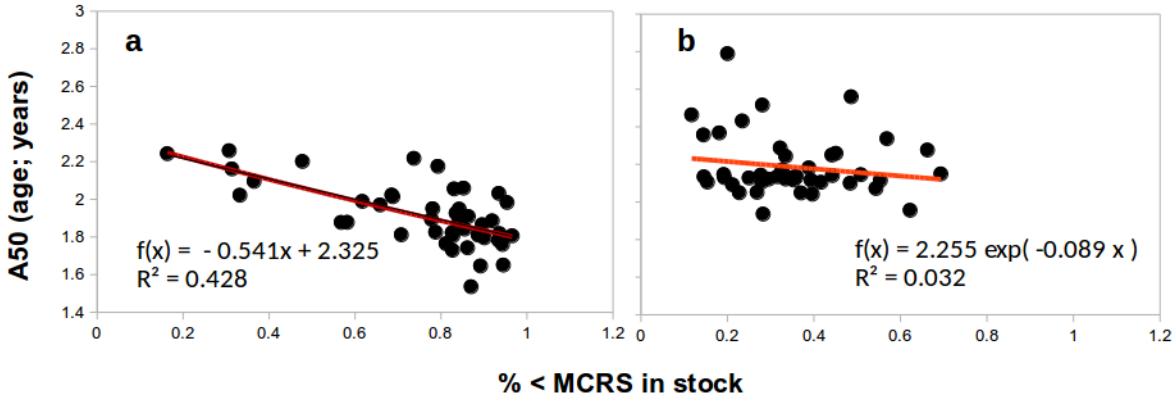


Figure 6.12. Age at 50% selection (A50) at the population-level in relation to the proportion of undersized fish in the population by weight for a stock with high recruitment variability (North Sea haddock) (a), and a stock with reduced recruitment variability (North Sea sole) (b). The metrics were calculated using stock assessment data for 1972-2014 (ICES 2015).

Some or all of these metrics, especially the ones with a lower correlation to the population structure, could be monitored on an annual basis, based on the stock assessments produced. That would allow the detection of possible LO effects at the stock level. If there are no changes detected, there should be further investigation at the fleet/vessel level to specify the reasons for that.

This list of metrics is not exhaustive, there are more metrics that could be developed and used in the future (e.g., catchability-based metrics, partial Fs; STECF 15-05). Future STECF EWG meetings on the implementation of the LO would allow further exploration of the list of candidate selectivity metrics and provide an opportunity to compare the relative effectiveness of these..

6.5 Potential spatial indicators and metrics for monitoring landing obligation effects

It is largely acknowledged that the occurrence of unwanted catches, which are or will be subject to LO, is frequently a heterogeneous phenomenon depending on space (area of fishing activity – Uhlmann et al., 2013), time (i.e. the period/season of the year - Gorelli et al., 2016), gear characteristics (e.g. mesh size), and fleet structure. Accordingly, the monitoring of the spatio/temporal pattern of fishing activities, if combined with an appropriate knowledge of fish population (resource) distribution (in particular the components of critical life stages that generally form a large portion of unwanted catches), is expected to be useful for assessing the progressive implementation of the LO. The rationale of this approach builds in three key sources of information:

1. Classical studies about the distribution of species targeted by the commercial fisheries (see Gerritsen et al., 2012 and Figure 6.13);
2. The recent progress in mapping the distribution of critical life stages and of sensitive habitats (e.g. Colloca et al., 2009; 2015, Nagelkerken et al., 2013, Tserpes et al., 2008, Carlucci et al., 2009; Garofalo et al., 2011 – see Figure 6.14 for an example);
3. The consolidation of powerful approaches for tracking, analysing and mapping the fishing footprint.

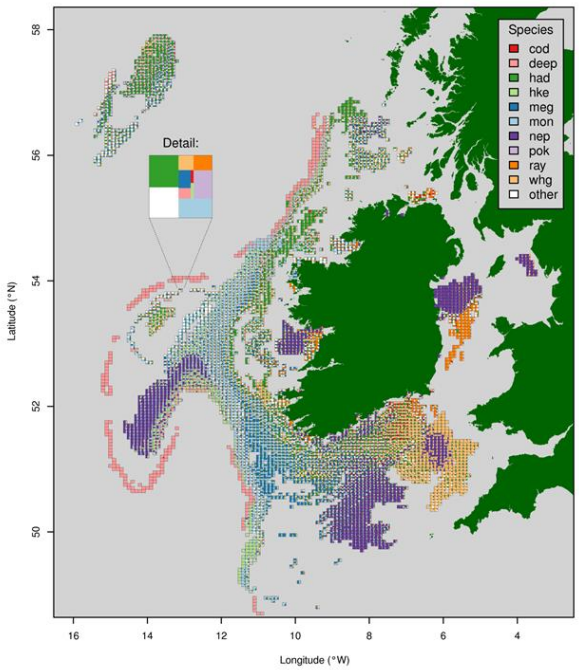


Figure 6.13 – Distribution of otter bottom-trawl effort west of Ireland during the years 2003–2009, and the distribution of catches of different species associated wit that effort. Note the anglerfish distribution towards the shelf edge and the distribution of whiting to the southeast of Ireland.

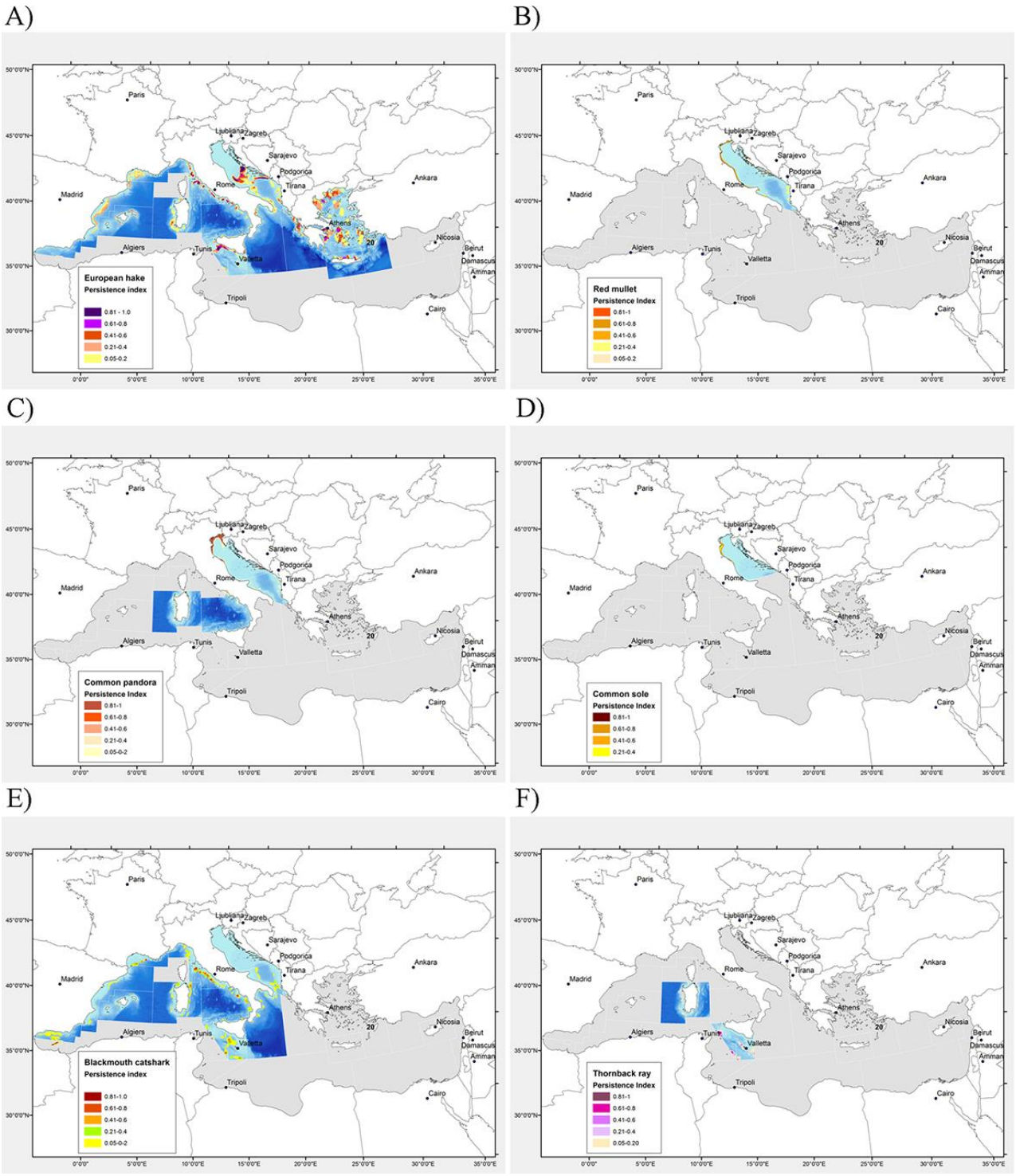


Figure 6.14 - Distribution maps of persistence index (Ii) of nursery areas of commercial fish in the North Mediterranean Sea. (from Colloca et al., 2015)

The development of remote tracking platforms (i.e. the Vessel Monitoring System – VMS – and the Automatic Identification System – AIS) and of a suite of dedicated methodologies (Hintzen et al., 2012; Russo et al., 2014; Natale et al, 2015) facilitates the generation of high definition maps of the fishing effort at the required temporal scale. Moreover, when data from these tracking systems are combined with catch data (e.g. cross comparison of logbook data with VMS as first described by Bastardie et al. 2010) it is potentially possible to obtain assessments of the

fishing footprint for almost all the gears/metiers present in the EU waters. Furthermore, the Data Collection Regulations (EC, No 199/2008), which describe a framework for the collection, management and use of data required to support scientific analyses of fisheries and to support provision of sound scientific advice for the implementation of the Common Fisheries Policy, established the use of VMS data for the routine computation of three indicators of fishing pressure. These three indicators are defined as follows (ICES, 2009):

- **DCF Indicator 5**: **Distribution of fishing activities.** An indicator of the spatial extent of fishing activity. It would be reported in conjunction with indicator 6. It would be based on the total area of grids (3 km × 3 km) within which VMS records were obtained, each month.
- **DCF Indicator 6**: **Aggregation of fishing activities**. An indicator of the extent to which fishing activity is aggregated. It would be reported in conjunction with the indicator for 'Distribution of fishing activities'. It would be based on the total area of grids (3 km × 3 km) within which 90% of VMS records were obtained, each month.
- **DCF Indicator 7**: **Areas not impacted by mobile bottom gears**. An indicator of the area of seabed that has not been impacted by mobile bottom fishing gears in the last year. It responds to changes in the distribution of bottom fishing activity resulting from catch controls, effort controls or technical measures (including MPAs established in support of conservation legislation) and to the development of any other human activities that displace fishing activity (e.g., wind farms). This indicator could be reported annually and would state the total proportion of the area by depth strata (0– 20 m, 20–50 m, 50–80 m, 80–130 m, 130–200 m, >200 m) in each marine region that has not been fished with bottom gear in the preceding one-year period.

Notice that each of these indicators is computed with respect to the level 6 of the current EU scheme (https://datacollection.jrc.ec.europa.eu/wordef/fishing-activity-metier) of metiers for classification of the fishing activities, as originally requested by the DGMARE. In more detail, the level 4 describes gear types, the level 5 disaggregates fishing activities by target assemblage, and level 6 further distinguishes fishing activities by mesh size and other selective devices. The DGMARE request indicates that activity information is required disaggregated to métier level 6. Accordingly, studies have been carried out to evaluate the current trends for these indicators and some methodological aspects of their computation (Piet, 2012; Lambert 2012; Russo et al., 2013).

The current framework may be visualised in Figure 6.15 which summarizes the types of available fishery and biological data and how the fishing effort in space and time could be considered before and after the onset of the landing obligation.

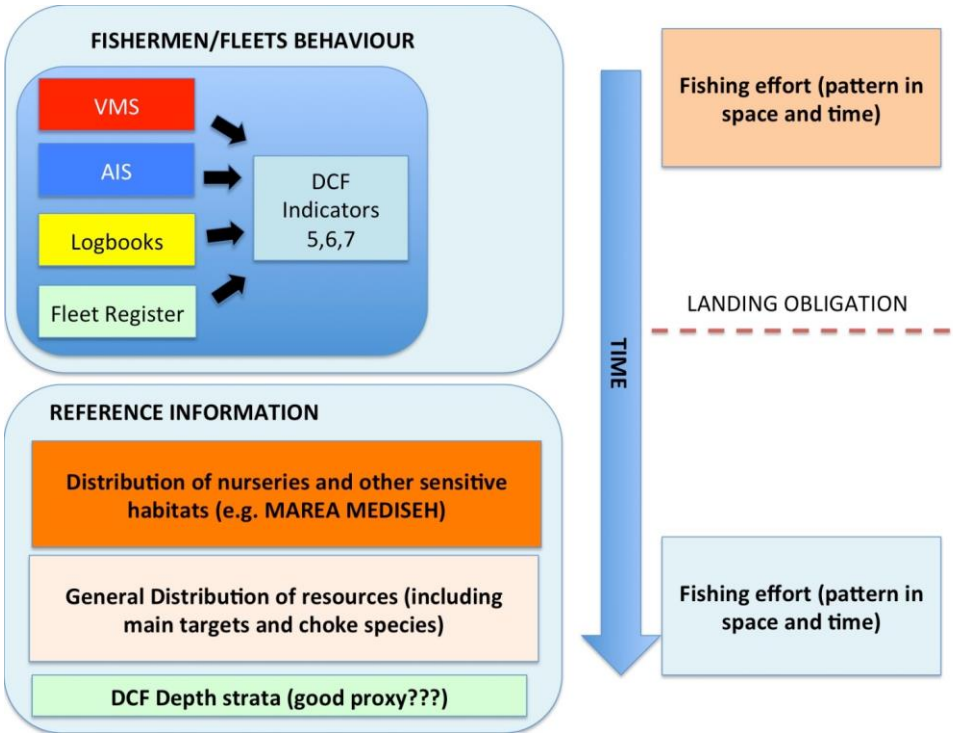


Figure 6.15 - Current framework for monitoring LO effect in terms of spatial and temporal pattern of fishing effort

The emergence of new methods and data sources is stimulating new management approaches, based on the understanding (and/or modelling) of discards occurrence in space and time. In fact, some recent research projects, such as the H2020 RIA project "SCIENCE, TECHNOLOGY AND SOCIETY INITIATIVE TO MINIMIZE UNWANTED CATCHES IN EUROPEAN FISHERIES" (MINOUW), will try to propose management strategies for avoidance and minimization of unwanted catches (art. 14 of the Reg. EU 1380/2013) in towed gear fisheries, by utilising pilot studies to identify areas where the probability of catching species which have no or low commercial values is highest. The basic idea is to adopt specific technical measures in these areas to minimize capture of unwanted species and sizes of fish subject to the discard ban (art. 15 of the Reg. EU 1380/2015). These measures i) range from complete trawling bans to the use of modified trawl nets and/or the adoption of fishing behaviour to avoid unwanted catches and ii) are considered within the framework of the spatial based approach to fishery management. More generally, the regulation of fishing effort in space and time may be beneficial, and some authors have proposed spatio-temporally explicit tariff-based approach combining multiple drivers to achieve sustainability goals by incentivising responsible fishing (Kraak et al., 2012; 2014; 2015). Some authors (Eliasen and Bichel, 2014) proposed a strategy of time-place selectivity by sharing real-time data and information about areas with high abundance of unwanted species and sizes (hotspots). The voluntary information sharing for avoiding hotspots is discussed in relation to existing time-place regulations as well as incentives for sharing of such information.

Alongside these potentially effective tools to minimize discards through the regulation of fishing effort in space and time, there is a fundamental need to set up metrics and/or indicators to capture whether there have actually been LO-driven changes in the spatio/temporal pattern of fishing effort. According to recent studies, the implementation of the LO is likely to result in significant changes in the fishing activity, mainly in terms of fishing strategy, selection of the time/area of activity, gear characteristics, and so on. Batsleer et al. (2016) used a simulation approach to demonstrate that, under a discard ban, fishing is restricted to the areas (fishing grounds) and time where the maximum revenue can be realised with other species while catching the quota of the restricted species with a reduced by-catch of undersized fish.

Developing robust indicators is not without difficulties given that all the available tracking systems are affected by some limits (see Russo et al., 2016. VMS is affected by a lower frequency

with respect to AIS but covers a larger portion of the fleet. Furthermore AIS mainly operates near the harbours, so that offshore activity is underrepresented. The integration of VMS and AIS data, however, maximises the strengths and minimizes the limits of each source. In fact, the assessment of the total spatial extent of fishing activities is significantly improved by the integrated use of VMS and AIS data.

Further improvements could be made through the cross-analysis of catch data or survey based data together with the spatial pattern of fishing effort. This is, more or less, the idea explored in MINOUW (as refereed above). The main problem in this framework is that DCF data for catches are not always collected at an appropriate spatial and temporal scale.

These observations indicate that inn common with many fishery management tools, the application of spatial methods and data to the assessment of LO-driven changes in fishing effort has advantages and disadvantages ('pros and cons'). Table 6.3 summarizes the main features of the proposed methods in terms of a swot analysis

Table 6.3 - SWOT analysis of the available methods and data sources in this framework

Origin	Strengths	Weaknesses
Internal (related to data and methods)	• Suitable methods are already available to map fishing effort • DCF already comprises pressure indicators that could be easily modified for LO-related purposes (without asking raw VMS/AIS data from the MS)	• Poor or incomplete coverage of the fleet for some MS • Incomplete knowledge of spatial and temporal pattern of discards
	Opportunities	**Threats**
External (related to fisheries)	• Stimulating informed changes in fishermen behaviour (*sensu* Kraak et al., 2012; 2014; 2015)	• Confusion in recognizing the true drivers of the changes in fishermen behaviour? A posteriori analyses

Clearly, the application of spatial methods for assessing the implementation of the landing obligation through changes in fishing activity implies the availability of spatial data on fleet activity and fish distributions. As discussed, this is increasingly becoming available through new technologies but is, for the present not available for all fishing vessels. Over the course of next few years, coverage will likely increase but in some areas, such as the Mediterranean, progress is likely to be slower.

According to García-Rivera et al. (2015) and Damalas (2015), the successful implementation of the LO in the Mediterranean waters could be impaired by certain characteristics of the fisheries. For example, remote tracking systems (VMS and/or AIS) are mandatory only for fishing vessels with LOA ≥ 12 m. Given that the largest portion of Mediterranean fleets is represented by small boats, the assessment of the actual fishing footprint is therefore limited. Similarly, the preponderance of small vessels also potentially affects the documentation of catches since logbook use is mandatory only for fishing vessels with LOA ≥ 10 m, and catches 'less than 50 kg per species' are not required to be reported.

Despite some of the current limitations, an operative approach to assess the LO-driven changes in the spatial and temporal pattern of fishing effort can be defined. Critically, interpretation of the

changes in spatial pattern requires knowledge about the distribution, in EU waters, of resources and of critical components of catches (for example, juveniles or choke species). The approach could begin initially with the assessment of fishing effort changes (if any) and the interpretation of these changes in pilot study areas (at least one for each member state). These areas could be selected on the basis of available information on the distribution of choke species, of critical life stages, and of sensitive habitats. In these areas, the approach would be to combine the DCF indicators of fishing pressure described above in order to obtain some basic spatio/temporal indicators explicitly devised to assess the extent of LO-dependent changes.

Two candidate indicators are described in Table 6.4. One of these relates to bathymetry which may be applicable in areas where discarding is typically related to depth. The second focuses on critical areas related to the distribution of small fish or choke species:

Table 6.4 - List of the spatial indicators to assess LO-driven changes in the spatial and temporal pattern of fishing effort

Indicator name	Specifications	Notes
Distribution of fishing activities by depth (DFAD)	• It should refer to the same 3 km × 3 km grid used for DCF indicators (or smaller); • It should be computed on a monthly frequency (according to the DCF indicators 5 and 6) in order to capture seasonal or sub-seasonal trends; • It should be based on the depth strata (0– 20 m, 20–50 m, 50–80 m, 80–130 m, 130–200 m, >200 m) defined for the DCF indicator 7. It should be computed for each of the metier of level 6 defined within the DCF	The computation of the indicator by depth strata is justified by the fact that: o Discarding patterns also seem to be depth-dependent and there are several studies indicating that discarding increases with increasing fishing depth (Machias et al., 2001; D'Onghia et al., 2003); o Thus, the progressive changes determined (also) by the implementation of the LO could be also interpreted in terms of absolute changes of the fishing effort and of changes in the relative proportion of fishing effort for the different depth strata. Scientific evidences in this direction could allow extending this analysis to other areas in which maps of distribution of resources and of critical stages are not already available;
Proportion of fishing activities in critical areas	• It should refer to the same 3 km × 3 km grid used for DCF indicators (or smaller); • It should be computed on a monthly frequency;	The definition of critical areas should be related to the specific pilot area under examination, and should comprise one (or more) of the following categories: 1. Areas with high presence of choke species; 2. Nursery areas; 3. Sensitive habitats.

6.6 Metrics and indicators of socioeconomic impacts

Socioeconomics encompasses a wide range of activities and a complex interplay of different players and elements in the overall fishing operation and subsequent fate of the catch. In an effort to capture this complexity, this section is structured as follows:

i. Introduction. Big questions, short and long term, positive and negative effects, direct and indirect effects – showing causality.
ii. Fleet – metrics and indicators to observe changes in:
    a. Operational

b. Financial
c. Economic
d. Social

iii. Upstream businesses - metrics and indicators to observe changes in:
   a. Operational
   b. Financial
   c. Economic
   d. Social

iv. Downstream businesses - metrics and indicators to observe changes in:
   a. Operational and Financial
   b. Economic
   c. Social

v. Consumption and markets - metrics and indicators

vi. Administration costs for MS

Introduction

The important big questions about the social and economic impacts of the implementation of the LO relate to:

- impacts on survival and performance of businesses (will vessel businesses fail or flourish? Will processing businesses suffer decrease in required raw material or benefit from an abundance of previously unavailable raw material?)
- impacts on jobs (number of jobs in fleet and directly related businesses, wages, changes in workload and working conditions); and
- impacts on social aspects (shifts in type of employment available, unemployment in affected communities, criminalisation of previously required activities).

These types of impacts might be different in the first few years after LO implementation and may change in the longer term. Perhaps there might be some business failures in the short term and remaining businesses might do better after some years. Or, the LO may take some years to be more fully and uniformly implemented by all catching businesses throughout Europe and some of the effects observed may start slowly and continue to grow over those years. In this section we have tried to suggest metrics and measurements that would be useful for both immediate and longer term effects and for both positive and negative effects.

Some outcomes such as numbers of active and inactive vessels can be directly and straightforwardly observed from national fleet registers and log book data. However, it is clear that an observation of change in outcomes (e.g. number of active vessels) that occurs after a policy change is not necessarily caused only or mainly by the effects of the policy change, but could also be influenced by other external and unrelated factors, such as prices in global markets, availability of labour, migration rules, technological developments or shifts in the natural environment. In order to robustly be able to claim that an observed effect is an impact of the LO implementation, there might have to be some linking evidence, which could be qualitative or quantitative.

Nevertheless, in this section, various metrics and indicators that could potentially show the effects and impacts of the LO implementation are presented and their interpretation would have to depend on what else was known about other factors influencing these outcomes and/or the existence of linking evidence.

Some of the more detailed evidence that is not already collected may be costly to collect, collate and analyse, and therefore those wishing to know or understand the impacts of implementing the LO will have to consider the value of detailed evidence compared to the cost of producing it. By including suggestions in this report, there is no implied suggestion that these metrics would be "worth the cost" of collecting and analysing the data required.

A general caveat attached to all suggested metrics and indicators is that their applicability will vary according to the style of fishing sector, the sea basins that the fleet fishes in, the type of quota allocation system used in the MS and other factors. Some metrics may not be applicable at

all in some MS but highly indicative of impacts in others, e.g. value and concentration of ownership (or holding) of tradable quota units. This impact can only be observed if the MS has quotas at all and also has tradable quota units.

Economic and social impacts of implementing the LO arise from operational changes and financial impacts initially on the fleet, hence our inclusion of some operational and financial metrics in this section, as these can provide linking evidence between observes outcomes (e.g. number of active vessels, number of FTEs in the fleet) and the implementation of the LO. The diagram in Figure 6.16 shows a flow chart of these knock-on effects including on businesses upstream (suppliers to) and downstream (customers of) of the fishing fleet.

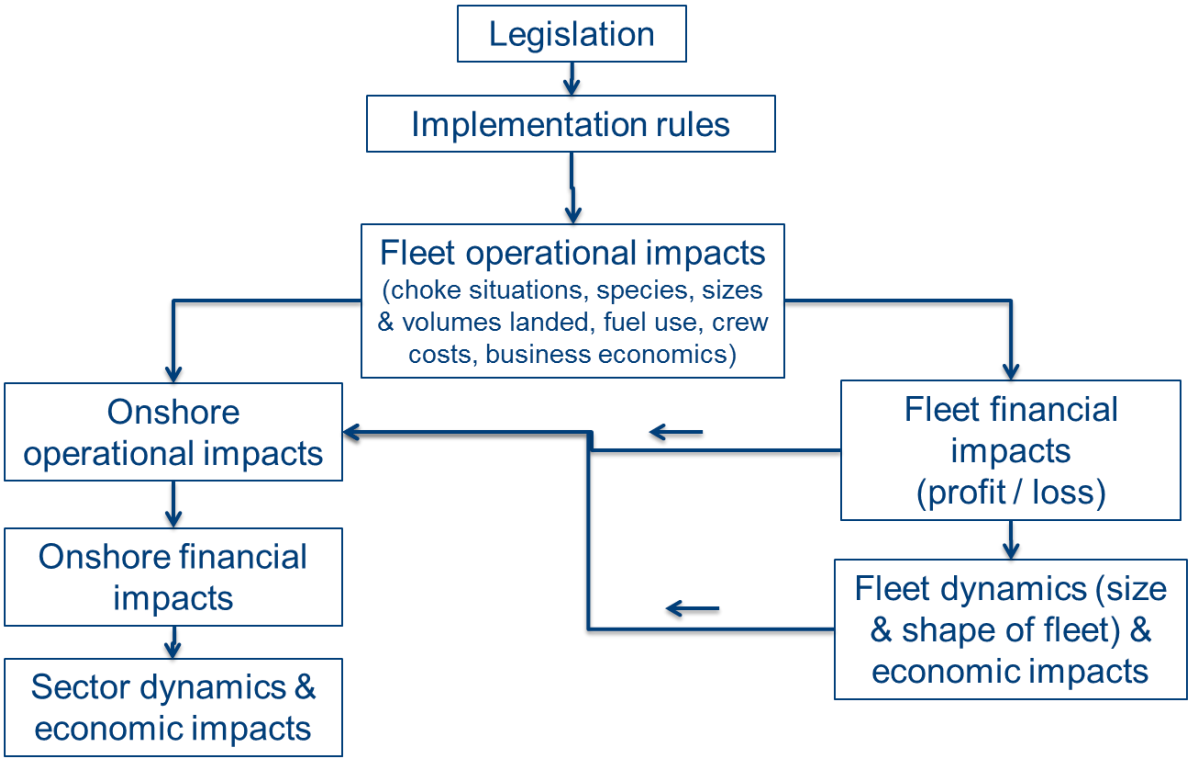


Figure 6.16 Influence and effects of the LO on the fleet and subsequent financial and economic effects on the fleet and associated industry sectors. (adapted from a Seafish diagram with permission).

Fleet impacts

From the Annual Economic Report produced by STECF several of the existing measures recorded could be included in a review of possible impacts of the LO implementation. Figure 6.17 shows an example of an overview of a national fleet with yellow stars to indicate which measures might be useful for detecting the impact of the LO. Other data already in the AER is mentioned throughout this section of the report.

Table 5.22.1 Swedish national fleet structure, fishing activity and production trends: 2008-2014.
Arrows indicate change (Δ) 2014 to 2013(structure) and 2012: (↗) increase; (↘) decrease and (↔) stable/no change (Δ between -1 and +1%)

	VARIABLE	2008	2009	2010	2011	2012	2013	2014	%Δ 2013-12	%Δ 2008	Trend
Structure	Total No. Vessels (#)	1,507	1,471	1,415	1,359	1,322	1,299	*1,267*	-2% ↘	-14%	
	No. of Inactive vessels (#)	359	339	351	328	303	315	*290*	-8% ↘	-12%	
	Average vessel age (year)	31	32	31	31	32	32.2	*33*	2% ↗	4%	
	Vessel tonnage (thousand GT)	43	42	39	33	30	30.5	*29*	-5% ↘	-29%	
	Vessel power (thousand kW)	212	208	196	178	169	171	*164*	-4% ↘	-19%	
	No. of Enterprises (#)	1,211	1,181	1,134	1,089	1,055	1,035	*985*	-5% ↘	-15%	
Employment	Total employed (#)	1,980	1,758	1,765	1,679	1,663	1,577	*1,543*	-5% ↘	-20%	
	FTE (#)	1,133	1,019	990	974	942	886	*851*	-6% ↘	-22%	
	Average wage per employed (thousand €)	15.1	14.8	16.3	17.3	18.4	21.2	*18.6*	15% ↗	40%	
	Average wage per FTE (thousand €)	26.4	25.5	29.1	29.9	32.4	37.6	*33.8*	16% ↗	42%	
Fishing Effort	Days at sea (thousand days)	103	97	85	84	79	78	*78*	-2% ↘	-24%	
	Fishing days (thousand days)	103	97	85	84	79	78	*78*	-2% ↘	-24%	
	Energy consumption (milion litres)	41	62	54	41	47	48	*44*	2% ↗	17%	
	Energy consumption per landed tonne (l/T)	193	312	265	236	347	273	*267*	-21% ↘	41%	
Output	Landings weight (thousand tonnes)	214	199	204	173	136	178	*166*	30% ↗	-17%	
	Landings value (million €)	122	105	114	126	125	131	*111*	5% ↗	7%	
	Recreational catches of selected species (T)	315	299	500	518	575	758	*758*	32% ↗	141%	

*all monetary values have been adjusted for inflation - constant prices 2014; when not provided by MS, figures for 2014 are projected based on several assumptions (see methodology section) and using fleet segment level data, which may not always be complete.

Data source: DCF 2015 Fleet Economic (MARE/A3/AC(2015)); data for 2014 are provisional.

Figure 6.17 Example of national fleet structure, activity and production trends from the Annual Economic Report produced by STECF (source: The 2015 Annual Economic Report of the UE Fishing Fleet (STECF 15-07)).

Fleet operational impacts

Most of the indicators of fleet performance, as shown in the AER, could show effects of implementing the LO, but these indicators are also dependent on multiple other factors, and in many cases it is difficult or impossible to say that one factor or another was a dominant cause of any trends or inter-annual changes.

In addition to showing trends of observations, and attributing changes in outcomes to a policy change, in order to show the impact of a change in policy, it may be considered useful to look at observations for the reference year, and compare to estimates of what those observations might have been in the same reference year had the LO not been implemented. This allows for the effect of external forces to be the same in both cases, effectively holding all else equal except the policy change.

Information relating to operational efficiency of vessels

Operational efficiency ratios such as fuel use per day at sea, fuel use per tonne landed, tonnes landed per day at sea and average duration of trip would be useful to observe and consider. These observations might reflect changes to fishing activities resulting from the operators' desire to avoid catching unwanted fish (by technical or gear adjustments or by spatial and temporal changes to fishing patterns) and from the obligation to retain and land fish that previously would have been discarded.

These metrics could be considered at national fleet level and at fleet segment level, depending on the desire to understand the impacts of the LO at different levels of detail.

Some of these metric values may have been moving in a steady trend for some fleet sectors and a distinct change in trend steepness or direction observed from the first year of the LO implementation could indicate the effects of changes in fishing practices that occurred due to compliance with the LO, but careful interpretation is essential to avoid drawing wrong conclusions about causality.

Information relating to choke stock situations

One of the undesired possible effects of the LO is the possibility of vessels having to stop fishing in a sea area before the year end and before having caught and landed all of their quota, because they have caught all of their quota of one stock in that sea area and the MS will not allow it to risk catching any more by continuing to fish for other species.

Information not currently collected that could indicate the presence, scale and impact of choke situations might include:

- Number and proportion of vessels per fleet segment that experience a choke situation – number of vessels required to stop fishing in a sea area, with a given gear type.
- Number and proportion of POs per MS that experienced a choke situation – in which all quota for a given stock held by members of the PO has been caught before the year end requiring all vessels in that PO to stop fishing in the relevant sea area with gear that might catch the fully caught stock.
- If there were any MS-level chokes - a MS national fleet choked on any particular stocks. Eg. MS fleet landed all of a MS TAC for a stock before end of year and with other quota unused (Category 2 choke).
- If there were any EU-wide chokes – eg. All of a EU TAC for a single stock was landed before the end of year and with other stocks uncaught in the same sea area (Category 3 choke).
- Anticipated (projected, forecast) chokes vs observed chokes
    - Are there any stocks that were anticipated to be chokes but were not? Was non-compliance with the LO rules the only likely explanation of why they were not?
    - Are there any observed choke situations that were not projected, anticipated? What was different in reality compared to projections?
- Quota uptake - total tonnes landed as % of permitted annual landings. Compare to quota uptake for same stocks in years before LO was implemented.

Information that might be helpful that is already collected via the DCF are total per segment and average per vessel fishing days per year; and, fishing days as proportion of 3 year average before the LO was implemented. The relevance or usefulness of this information will vary according to what management restrictions the vessels were subject to before the implementation of the LO. For instance, if vessels were restricted in their days at sea per year as part of a stock recovery plan, but are no longer subject to that restriction after the implementation of the LO, then this complicating factor would have to be taken into account when interpreting a comparison of activity before and after the LO.

Fleet financial impacts

Business operational changes lead to changes in costs and revenues and have subsequent effects on profit and business success or failure.

Impacts affecting Business economics

Because sales prices of fish are affected by several key factors, many of which would not be affected by the LO, it could be useful to look at the factor that is most likely to be directly affected by the LO, namely fish size grade profile of landings. It could be useful to compare revenues per fish size grade before the LO to revenues per size grade after the LO. It could be expected that there might be higher volume and proportion of landings of under size and small size fish and, possibly, a lower volume and proportion of landings of larger size fish, if, in each trip, the smaller fish that previously would have been discarded must now be retained and therefore a full fish room on board will include small fish that would not previously have been included. The space taken up by small fish after the LO might have been filled with bigger, higher priced, fish before the LO. Prices achieved for the various fish size grades after the LO is implemented could be applied to the volume of each size grade landed before the LO and after the LO. Undersize fish may have, in effect, a negative sales price if rather than someone else

paying the vessel for the fish, the vessel business has to pay someone to dispose of the fish, if the fish is unwanted by any business as a raw material.

In order to illustrate the possible effects on revenues of changes in size grade profiles of landings it might be useful to estimate foregone revenues or additional revenues resulting from the change. Presented below (Figure 6.18) are some calculations showing possible outcomes for a single vessel after LO, compared to pre-LO. These are just quickly produced illustrations rather than a well thought-out and tested metric, but this approach could be developed into a useful metric for groups of vessels on an annual basis.

Fish size Revenue - worked illustration

example of one trip of one vessel, constrained to landing 50 tonnes

fish size grade	assumed PreLO prices	actual observed avg price/disposal cost per tonne	Estimated tonnes caught before LO	landing before LO	Catch after LO	Landing after LO	revenue before LO	revenue after LO	Foregone Revenue (FR)	FR as % of pre-LO revenue	post-LO as % of pre-LO revenue
<MCRS	0	-£100	10	0	7	7	£0	-£714			
4	250	250	10	0	7	7	£0	£1,786			
3	900	950	15	15	11	11	£13,500	£10,179			
2	1200	1300	20	20	14	14	£24,000	£18,571			
1	1500	1600	15	15	11	11	£22,500	£17,143			
			70	50	50	50	£60,000	£46,964	£13,036	22%	78%

Assume limiting factor is e.g. 50 tonnes of quota or e.g. capacity for 50 tonnes in fish room so post LO the vessel stops fishing once it has caught 50 tonnes
Pre-LO landings based on official landings data showing size grades of fish (comes from sales notes).
Size grade profile of both pre- and post-LO catch is identical while pre-LO landings profile reflects estimated discards.
Assumed pre-LO prices are to reflect possible increased prices for larger sizes due to increased scarcity after LO

Assuming quota uplift and no vessel capacity constraint

fish size grade	assumed PreLO prices	actual observed avg price/disposal cost per tonne	Estimated tonnes caught before LO	landing before LO	Catch after LO	Landing after LO	revenue before LO	revenue after LO	Foregone Revenue (FR)	FR as % of pre-LO revenue	post-LO as % of pre-LO revenue
<MCRS	0	-£100	10	0	10	10	£0	-£1,000			
4	250	250	10	0	10	10	£0	£2,500			
3	900	900	15	15	15	15	£13,500	£13,500			
2	1200	1200	20	20	20	20	£24,000	£24,000			
1	1500	1500	15	15	15	15	£22,500	£22,500			
			70	50	70	70	£60,000	£61,500	-£1,500	-3%	103%

Assume that vessel is not limited by fish room capacity and that quota uplift matches previously discarded quantities
Pre-LO landings based on official landings data showing size grades of fish (comes from sales notes).
Size grade profile of both pre- and post-LO catch is identical while pre-LO landings profile reflects estimated discards.

Figure 6.18 Approach to estimating revenue impacts of change in fish size grade profile of landings, that could be developed into a useful metric.

In addition to any additional revenues from under size fish, it would also be useful to report the segment total and average per vessel annual spend and price per tonne for disposal of unwanted and unsold landings.

Impacts causing Choke situations

It would be useful to collect information on the number of business failures reported as being caused by choke situations. Possibly POs or other representative bodies (depending on the MS and vessel type) could report and provide evidence of the choke situation and tie up of affected vessels. It would also be useful to record the number of all vessel business failures, even though, other than in choke situations, it may be difficult to evidence if each business failure was due to effects of the LO.

Prices and values of fishing rights, particularly quota units, would be expected to be affected by the LO and so information on these would be of interest. These values are already estimated and presented in the AER. However it is difficult to collect data on observed trades and published figures are usually estimated or imputed based on value of landings or some other top-down approach. Any evidence relating to price changes in quota units for lease (in-year) or sale (for future years) would be useful in showing possible effects of the LO. It could be expected that

prices for quota could be very high in a year when there is a widely-expected choke situation up until a choke occurs. After a group of vessels experienced a choke situation (all quota units for that stock had been caught), prices of quota for other stocks that can no longer be caught due to tie-up of vessels, might then fall to zero or near zero. Although it is not clear at this stage exactly what data or information for each MS could be collected, reliable information about the trade prices of quota would be useful.

Average fish sales prices within a MS, per size grade, before and after any fleet-wide choke situation within a calendar year would also be useful information to show financial impacts of the LO.

Some financial impacts could be illustrated by data already collected, analysed and presented in the AER. These metrics already published include:

- Total landings income
- Labour costs
- Fuel costs
- Repair costs

It might also be useful to observe non-fishing income as a proportion of total income, in case there is an effect of vessels being used for alternative income-generating operations other than fishing to a different extent than before the LO.

Table 5.16.2 Dutch national fishing fleet economic performance in 2008-2013 and projections for 2014.
Development trend based on %Δ net profit margin 2013 to average net profit margin 2008-2013. Arrows indicate change (Δ) 2013 to 2012: (↗) increase; (↘) decrease and (↔) stable/no change (Δ between -1 and +1%)

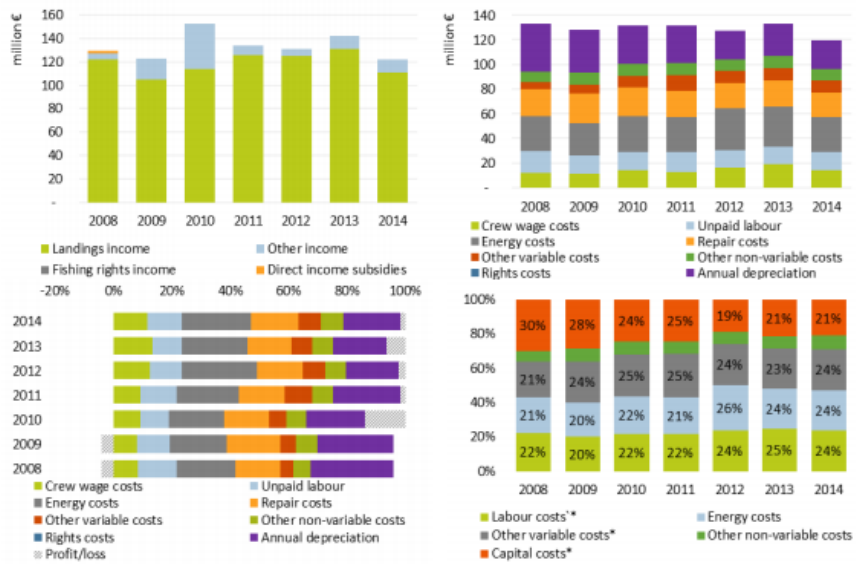
	VARIABLE (million €)	2008	2009	2010	2011	2012	2013	2014	%Δ 2013-12	%Δ 2008	Trend
Income	Landings income	406.8	334.0	358.1	342.2	359.3	343.8	*366.8*	-4% ↘	-15%	
	Other income	1.6	1.7	1.9	1.7	2.6	1.9	*2.0*	-26% ↘	22%	
Costs	Labour costs	113.7	100.7	102.3	87.1	99.7	96.2	*86.8*	-4% ↘	-15%	
	Energy costs	135.6	81.5	107.1	110.5	109.6	93.3	*88.9*	-15% ↘	-31%	
	Repair costs	57.0	60.6	55.5	59.2	61.4	47.2	*46.9*	-23% ↘	-17%	
	Other variable costs	37.6	31.5	35.6	31.3	29.0	27.7	*27.4*	-4% ↘	-26%	
	Other non-variable costs	50.1	45.6	45.5	44.8	39.3	40.0	*39.0*	2% ↗	-20%	
	Capital costs	65.0	59.2	61.2	55.9	42.7	53.3	*34.3*	25% ↗	-18%	
Economic Indicators	GVA	128.0	116.6	116.3	98.2	122.7	137.6	*166.6*	12% ↗	8%	
	Gross profit	14.4	15.9	14.0	11.2	23.0	41.4	*79.8*	80% ↗	189%	
	Net profit	-50.6	-43.4	-47.1	-44.7	-19.6	-11.9	*-4.3*	39% ↗		
Capital value	Depreciated replacement value	634.5	621.1	585.7	519.3	391.0		*146.4*			
	Investments	38.1	83.2	52.3	31.9	45.2					
Profitability and development trends	Net profit margin (%)	-12.4	-12.9	-13.1	-13.0	-5.4		*-3.3*			
	development trend										
	RoFTA (%)	-6.0	-4.3	-6.0	-8.1	-5.9		*-3.17*			
	development trend										
	GVA per FTE (thousand €)	68.0	66.6	64.9	57.6	71.3	77.9	*95.3*	9% ↗	15%	
	development trend			Improved					19% ↗		

*all monetary values have been adjusted for inflation - constant prices 2014; when not provided by MS, figures for 2014 are projected based on several assumptions (see methodology section) and using fleet segment level data, which may not always be complete.
Highlighted capital costs and Net profit exclude opportunity cost of capital.

Data source: DCF 2015 Fleet Economic (MARE/A3/AC(2015)); data for 2014 are provisional.

Figure 6.19 Highlighted (starred) metrics relating to income and costs that are already published in the AER, that might be useful for assessing the impacts of the LO. (Source: The 2015 Annual Economic Report of the UE Fishing Fleet (STECF 15-07))

Graphical presentation (Figure 6.20) of data already published shows how useful the existing AER could be for highlighting key financial and economic effects of the LO.



Data source: DCF 2015 Fleet Economic (MARE/A3/AC(2015)); data for 2014 are provisional.

Figure 5.22.4 Income and cost structure trends for the Swedish fleet: 2008-2014.
Top left – income structure; top right – cost structure; bottom left – cost items as a percentage of total income; bottom right – main costs items as a % of total costs (projected figures for 2014).

Figure 6.20 Graphs that are already published in the AER, that might be useful for assessing the impacts of the LO. (Source: The 2015 Annual Economic Report of the UE Fishing Fleet (STECF 15-07))

It will be important to estimate the value of any fish which previously would have been caught and sold, but which was not caught due to vessels choking on another stock and having to stop fishing. This estimated value would depend on the price attributed and the estimated volumes of uncaught fish. The appropriate price to use would be the average price per tonne year-to-date for the relevant fleet segment(s). Estimated volumes of fish that would have been caught in the absence of a choke situation would require careful estimation based on permitted catching opportunities (for both quota and non-quota stocks) and practices and catch rates per day of the fleets in question. The charts below Figure 6.21 are from scenario modelling relating to the LO and similar types of graphs could be produced either for groups of vessels or for groups of stock quotas. There would have to be linking evidence provided by POs or similar organisations confirming that quota remained uncaught because vessels had reached a choke situation and had been unable to catch remaining quota of other stocks.

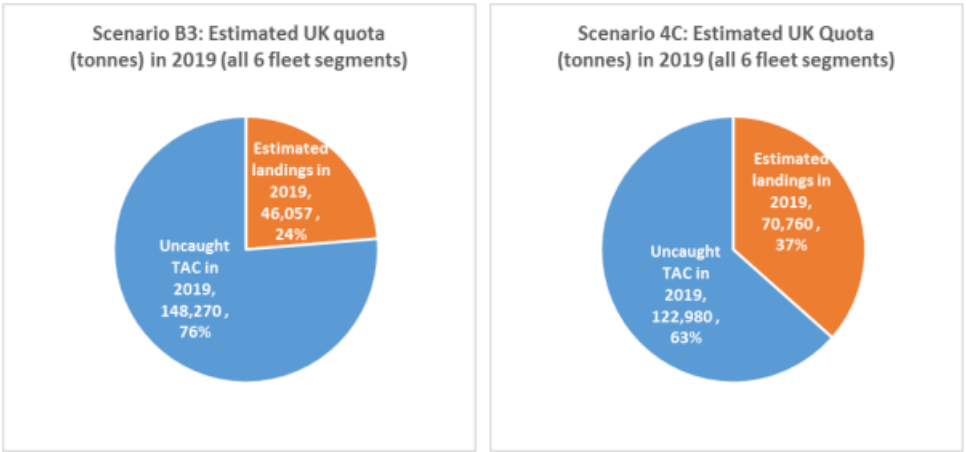


Figure 10-1: Total estimated landings by the six home nation fleet segments prior to all choke points being reached in 2019, as a proportion of the UK quota which the fleet segments could be expected to hold in 2019 under the EoY analysis. Results are shown for baseline scenario B3 and combined policy lever scenario 4C

Figure 6.21 Example of how estimated value of uncaught fish due to choke situations could be presented. Source: Russell, J. et al, Landing Obligation Economic Impact Assessment, Final Report. Seafish, Edinburgh, 2016.

Fleet Economic impacts

The shape, size and structure of fleets would evolve in response to any business failures, voluntary removal of vessels and any new catching opportunities or improvements in profit that might arise over time. In order to illustrate this MS might find it helpful to provide time series data for fleet segments more narrowly defined than the DCF fleet segments and show trends as illustrated below (Figure 6.22). (In particular, it might be useful to separate vessels landing majority whitefish from those landing majority *Nephrops*). These metrics would also reflect multi-vessel companies voluntarily reducing their number of vessels to ensure that remaining vessels can fish all year without choking (depends on individual quota allocation being in use).

AREA VIIA NEPHROPS OVER 250KW

		Trend 2005-2013	2005	2006	2007	2008
SEGMENT TOTALS	Active vessels (#)		35	34	35	35
	Power (kW)		11,864	11,700	12,351	12,043
	Registered Tonnage (GT)		3,480	3,479	3,571	3,337
	VCU (unit)		7,884	9,610	7,569	9,587
	Landings (tonnes)		3,572	4,108	4,203	4,602
	Fishing Income (£ million)		6.8	9.7	9.1	9.1
	Days at Sea (days)		6,504	6,120	6,024	6,018
VESSEL CHARACTERISTICS (AVERAGE PER VESSEL)	Length (m)		20.2	20.4	20.5	19.8
	Power (kW)		339	344	353	344
	Registered Tonnage (GT)		99	102	102	95
	VCU (unit)		225	283	216	274
	Landings (tonnes)		102.1	120.8	120.1	131.5
	Fishing Income (£'000)		194.6	284.6	260.3	260.7
	Days at Sea (days)		186	180	172	172
	Vessel Age (year)		29	30	32	32
	Landings per day at sea (tonnes)		0.55	0.67	0.70	0.76
	Average price per tonne landed (£)		1,907	2,355	2,168	1,983

Figure 6.22 Examples of useful time series data metrics for narrowly-defined fleet segments within MS. Source: Lawrence, S. et al, Fleet Economic Performance Dataset 2005-14. Seafish, Edinburgh. 2016.

From the fleet AER the following information (Figure 6.23) presented at DCF fleet segment level would also indicate fleet dynamics evolution over time, reflecting economic impacts of the LO.

Table 5.16.1 Dutch national fleet structure, fishing activity and production trends: 2008-2014.
Arrows indicate change (Δ) 2013 to 2012: (↗) increase; (↘) decrease and (↔) stable/no change (Δ between -1 and +1%)

	VARIABLE	2008	2009	2010	2011	2012	2013	2014	%Δ 2013-12	%Δ 2008	Trend
Structure	Total No. Vessels (#)	730	713	725	737	735	739	*736*	1% ↔	1%	
	No. of Inactive vessels (#)	161	133	152	186	185	192	*198*	4% ↗	19%	
	Average vessel age (year)	40	41	41	39	43	39	*30*	-9% ↘	-2%	
	Vessel tonnage (thousand GT)	156	139	137	131	135	129	*134*	-5% ↘	-17%	
	Vessel power (thousand kW)	339	296	294	289	288	276	*280*	-4% ↘	-19%	
	No. of Enterprises (#)	687	696	711	703	713	711		0% ↔	3%	

Figure 6.23 AER fleet structure metrics (Source: The 2015 Annual Economic Report of the UE Fishing Fleet (STECF 15-07))

Also from the AER (graphs illustrated below, Figure 6.24), the following further economic metrics would be useful:

- Investments – in gear, equipment and vessels. Not necessarily possible to link to LO but could have some elements backed up by qualitative data. For instance, MS could collect interview data from owners of new commissioned fishing vessels asking about their motivation, was the LO a factor in their decision to invest?
- Gross Value Added
- Gross Profit
- Valuation of fishing rights – increase in uncertainty reduces value of rights in perpetuity or open-ended rights.
- Changes in patterns of ownership (or holding) of fishing rights

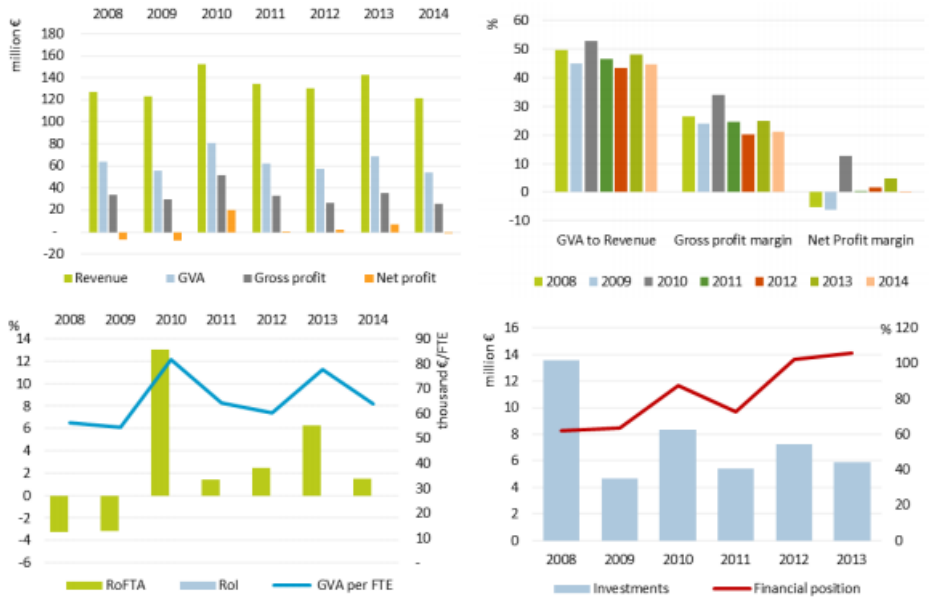


Figure 5.22.5 Main economic performance indicator trends for the Swedish fleet: 2008-2014.
Top left – economic performance indicators; Top right – performance indicators as a % of revenue (landings income + other income); bottom left – labour and capital productivity indicators; bottom right – in-year investment and financial position (projected figures for 2014).

Figure 6.24 AER economic performance metrics graphs (Source: The 2015 Annual Economic Report of the UE Fishing Fleet (STECF 15-07))

In the proposed EUMAP, subsidies on investment would be separated from operational subsidies. These indicators might also be useful to show impacts of the LO by revealing use of EMFF for fleet selectivity measures. Information on the EMFF funds used for modernisation of vessels, including improvement or enlargement of storage and improvement of selectivity, should be available at MS level through EMFF monitoring systems.

Fleet Social impacts

Social impacts of implementing the LO might be wide-ranging and many might not be captured or recorded by any data. Those that could be observed might include number of FTE jobs, average wages and indicators of levels of non-compliant business practices.

Given the possibility that some vessel operators may find themselves faced with a choice between going out of business or fishing in a manner not fully compliant with the rules of the LO, some vessel operators may choose the non-compliance option in order to stay in business. Criminalisation of previously legal business practices could be reflected by number of offences against the new rules that are recorded and reported.

The following metrics might be useful in assessing the social impacts of implementing the LO, but only if changes in values or trends can be shown to be a result of operating under the LO, and this causal link might not always be straightforward to demonstrate.

- Number of FTEs
- Wages /crew share
- Hours worked per week / month etc
- Number and proportion of non-EEA crew
- Incidence of non-compliant business practices – which may be a continuation of practices that used to be legally required but are now legally forbidden.

The number of hours worked on board by the crew should be available through FTE calculation, and other FTE ratios could be used for evaluation of crew efficiency indicators such as weight of landings per FTE. Changes in this metric could represent changes in the work load of crew and should be analysed at fleet level.

Increased use of both electronic monitoring and of observers on board fishing vessels may create a sense of being under constant surveillance or in a "Big Brother" society and this, in combination with the potential for increased criminalisation, could have social impacts. However, it may be difficult to observe and/or record these types of impacts. Expert social scientists might be able to advise on this matter.

The other relevant aspect of this issue is that in a scenario where control and legal aspects of LO implementation become significant sources of conflict, and where scientific observers are either perceived to be or are in reality fulfilling an enforcement role, then incidences of harassment of observers may become an issue, as has been reported from other fisheries globally. It might be useful to record incidence of observer harassment.

It might be useful to record and report the number of days spent by all interested parties in attending local, national and international meetings in order to implement the LO.

Table 6.5 Metrics and measurements for Catching sector business impacts
N.B. *indicates information is already collected and presented in the fleet or processing sector Annual Economic Reports or in the STECF balance report. Bold type indicates a particularly useful metric.

Operational	Financial	Economic	Social
• **Fuel use ratios** ○ **per tonne landed*** ○ per day at sea* • Total days at sea per segment • **Tonnes landed per day at sea*** • **Average trip duration** • **Vessel use indicator*** • **Number of choke situations** ○ **Vessel level** ○ **PO level** ○ **MS level** ○ **EU level** • **Ratio of anticipated chokes / observed choke situations** • **Quota uptake*** • **Ratio of landings for human/non-human consumption**	• **Sales prices per size grade of fish** • **Foregone Revenue due to change in size profile of landings** • Disposal costs for unsold fish • **Number of business failures attributed to choke situations** • **Total number of business failures** • **Value of fishing rights*** • **Fish prices pre and post fleet level choke** • Total landings income* • Labour costs* • Fuel costs* ○ Total* ○ Additional due to LO • Repair costs* • **Estimated value of uncaught fish**	• **Number of Vessels*** • **Number of inactive vessels*** • **Number of enterprises*** • **Inactive fleet indicator*** • Investments* • GVA* • **Operating (Gross) Profit*** ○ total per segment ○ average per vessel • Fishing rights values • Fishing rights ownership/allocation • Use of EMFF for vessel or gear adjustments to comply with the LO	• **Number of FTEs*** • **Wages/Crew share*** • **Average wages per FTE** • Working Hours* • Number and proportion of non-EEA crew • Incidence of non-compliant business practice. • Incidence of observer harassment • Weight of landings per crew member, by fleet segment.

Impacts on upstream businesses

Businesses that supply goods and services to the fleet (the sector immediately impacted by the LO) are likely to be impacted by changes in quantity, value and type of goods and services demanded by vessel businesses whose activities change in response to the LO.

Changes in the number of vessels and vessel businesses would affect the quantity of goods and services demanded by the fleet sector. Changes in fishing tactics and activities may change the type and quantity of fishing gear and other technological equipment required by vessel businesses. A new requirement to avoid catching certain common bycatch species might lead to a peak in demand for new fishing gear. Innovation in gear design might be needed more than previously and this might impact on the number and type of jobs in gear manufacturing companies as well as quantity and value of sales for gear companies.

Businesses supplying services to fishing businesses include ports, harbours and markets, with their possible supply of facilities and services for handling under size fish. Vessel building businesses would also be included and these businesses might, for instance, be asked to provide refits or modifications to vessels as they change their activities in response to the LO.

Upstream business operational and financial impacts

Information not currently collected, that might show impacts on upstream companies could include the following:

- Value of sales by companies manufacturing fishing gear
- Number of improved selectivity fishing nets (or other gear) sold
- Value of sales by boat builders to fishing industry
- Value of sales of fish finding or other on-board technology (this might be easier to collect from the fleet than from supplying companies)

- Any business failures, start-ups or expansions shown to be due to changes in demand from the fleet

Upstream business economic impacts

It may be considered useful by some MS to record the number of enterprises that have high dependency on sales to the fishing fleet.

Upstream business social impacts

Rather than recording information on jobs, it might be easier and more realistic to record reported incidents of increased or decreased business. E.g. Gear manufacturers might report a substantial increase in sales as vessel operators have a greater incentive to fish selectively. Or, overall, they might experience a substantial decrease if large proportions of the fleet go out of business due to choke situations. Both of these changes would be likely to impact number of jobs in the upstream sector. However, if it was felt to be important, some MS may wish to collect and present data on employment in the upstream sector. To show any changes resulting from the LO, it would be necessary to have pre-LO data as a comparison.

- Employment levels and wages in key companies supplying the fleet, which have a high dependency on business from the fishing fleet

Impacts on Processors

Businesses that depend on the supply of fish from EU fishing vessels may be impacted by the LO in a number of ways. There could be a decrease in the supply of fish species subject to quota, particularly of larger size grades. Choke situations, where fleets may be tied up or restricted in catching quota species, could have a particularly significant impact on supply. On the other hand these businesses may have access to previously discarded raw material, or they might have an increase in raw material supply due to quota uplift. The capacity, capability or willingness of processors to source alternative supplies or to capitalise on supply of previously unwanted size grades will vary and there is substantial uncertainty around which direction overall supply will take which is affecting their ability to engage in long-term planning. Some processors have indicated their willingness to fund selectivity trials with fishing vessels in order to reduce the risk of a substantial reduction in supply due to choke situations.

There could be some processing businesses that have relied on local or other EU landings and are unable or unwilling to change their supply sources if volumes landed decline due to choke situations.

Table 6.6 Metrics and measurements for Upstream businesses impacts
N.B. *indicates information is already collected and presented in the fleet or processing sector Annual Economic Reports or in the STECF balance report. **Bold type** indicates a particularly useful metric.

Operational and Financial	Economic	Social
• **Value of sales by gear manufacturers** • **Number of improved selectivity fishing nets sold** • Value of sales of on-board technology • Value of sales by boat builders to fishing businesses • **Number of business failures, start-ups or expansions**	• Number of highly fishing dependent enterprises	• FTEs • Wages • Number of high-technology jobs

Downstream businesses operational and financial impacts

The following types of information might be helpful in showing effects of the LO on processing businesses that are reliant on landings by vessels subject to the LO. However, it is important to note that these businesses have much more scope to change their activities in various ways as they are not directly required by the LO to change their activities in specific ways. In any data collection for this purpose it is important to focus on processors that have a significant dependence on species subject to the LO.

- Volume and value of sales (turnover)
- Volume of imported raw material to replace EU supplies no longer available due to the LO
- Any business failures, start-ups (e.g. biotechnology companies) or expansions shown to be due to changes in supply linked to the LO
- Volume of raw material purchased for non-human consumption
- Value of sales of products for non-human consumption

Data at species level are not currently collected from processors under the DCF and is not proposed in EU MAP, and there would probably be substantial costs involved in trying to collect such data on a systematic basis. It might be more realistic to conduct interviews with managers of businesses that claim to be affected by changes in quantity and type of raw material available to them from vessels subject the LO.

The graphs (Figure 6.25) and tables below are from the processing sector annual economic report and include information that might show effects of the LO, but as with all information on the processing sector, linking evidence to fleet effects would be necessary in order to be confident that any observed changes were caused by the effects of the LO on the fleets.

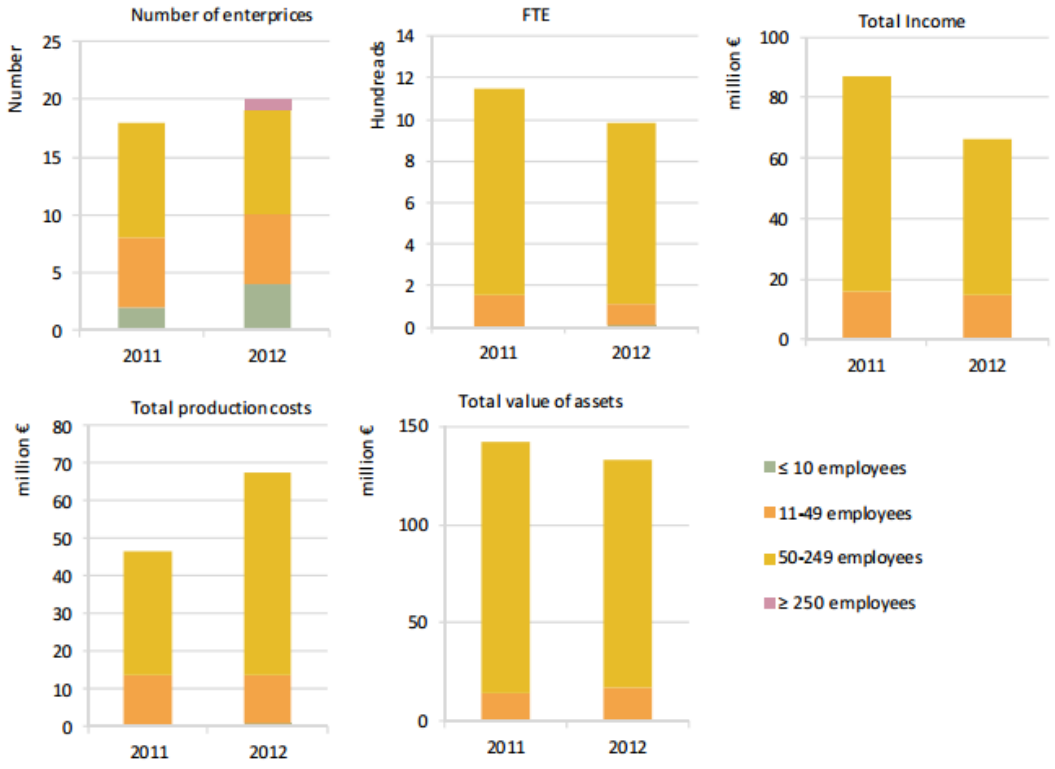


Figure 4.3.4: Croatian main structural and economic variables trends by size category, 2011-2012

Figure 6.25 Graphs showing metrics and data that might be useful to show effects of the LO on relevant fish processing businesses. Source: The Economic Performance of the EU Fish Processing Industry (STECF-14-21)

These graphs could be produced for processing businesses that were known to be strongly dependent on landings from EU fishing vessels. It would be important to remove from the group of businesses those that rely predominantly on vessels not subject to the LO, including some in the EU but dealing predominantly with stocks not affected by the LO.

Other useful metrics that are currently presented in the Processing AER are shown in the figure below, including

- Turnover (sales)
- Purchase of fish and other raw material for production
- Wages and salaries of staff
- Net investments

Table 4.3.2: Economic performance of the Croatian fish processing industry sector, 2011-2012

Variable	2011	2012	Δ (2011-12)
Income (million €)			
Turnover	45.8	48.0	5%
Other income	36.4	27.6	-24%
Subsidies	5.4	4.6	-15%
Total Income	87.6	80.2	-8%
Expenditure (million €)			
Purchase of fish and other raw material for production	18.8	21.5	14%
Wages and salaries of staff	13.3	15.7	18%
Imputed value of unpaid labour	0.0	0.0	0%
Energy costs	4.1	4.7	16%
Other operational costs	11.2	38.9	246%
Total production costs	47.4	80.8	70%
Capital Costs (million €)			
Depreciation of capital	9.6	7.5	-22%
Financial costs, net	4.3	4.3	0%
Extraordinary costs, net	0.2	0.1	-64%
Capital Value (million €)			
Total value of assets	142.2	174.9	23%
Net Investments	12.7	22.7	79%
Debt	60.5	73.9	22%

Figure 6.26 Table from Processing AER with stars highlighting metrics that might be interesting for showing effects of the LO on processing companies that purchase fish caught and landed in the EU. Source: The Economic Performance of the EU Fish Processing Industry (STECF-14-21)

Downstream businesses Economic impacts

For processing businesses reliant on landings by vessels subject to the LO, the following indicators might show any effects of the LO experienced by these businesses.

- Number of enterprises
- Gross Value Added
- LO-related strategic alliances e.g. Processors investing in selectivity trials or purchases of fishing rights
- Net Investments

Downstream business social impacts

Processing businesses are a significant source of employment and significant changes to their supply chain as a result of the LO could either create jobs or result in job losses. It may be

possible to link employment levels to LO implementation if LO related changes to supply are demonstrated.

The main social indicator in this category is Employment

- Number of FTEs
- Level of wages

Table 6.7 Metrics for Processing businesses reliant on landings by vessels subject to the LO

N.B. *indicates information is already collected and presented in the fleet or processing sector Annual Economic Reports or in the STECF balance report. **Bold type** indicates a particularly useful metric.

Operational	Financial	Economic	Social
• Volume of imported raw material to replace LO-caused foregone supplies • Volume of sales • Volume of raw material purchased for non-human consumption • **Business failures and start ups due to lack of raw material or availability of new raw material**	• **Value of purchased fish and raw material for production *** • **Turnover*** • **Total production costs*** • **Value of sales for non-human consumption**	• **Number of enterprises*** • GVA* • Strategic alliances eg. Processors engaging in gear selectivity trials or purchase of fishing rights • Net investments*	• **FTEs*** • **Wages***

Markets, retail and consumption

There are numerous ways in which the LO could impact on both consumers and non-human consumption markets for fish and fish by-products. In turn, market developments in response to the LO could have a feedback effect on practices by the fishing and processing sectors.

Relevant market aspects and issues on which it might be useful to report information include:

- Consumption of different product sizes of fish in retail and foodservice;
- Consumption of imported fish in retail and foodservice;
- Incorporation of LO related issues in environmental certification schemes;
- Consumption of new products based on fish by-products;
- Sales of non-human consumption products containing fish by-products;
- Sales of bait;
- Public attitudes towards discarding in general and the LO

Some of these effects or market outcomes may have economic and/or social effects over time and therefore it could be desirable to build up a baseline picture so that later trends can be detected and analysed.

If there is a desire to collect and present information relating to consumption and markets, further expertise would be required than was available at EWG16-04. It may be worthwhile seeking further expert input to this aspect, particularly from experts involved with the EUMOFA project.

Table 6.8 Metrics and measurements relating to impacts in Consumption & Markets

• Consumption of different product sizes of fish in retail and foodservice
• Consumption of imported fish in retail and foodservice
• Incorporation of LO-related issues in environmental certification schemes
• Consumption of new products based on fish by-products
• Sales of non-human consumption products
• Sales of bait
• Public attitudes towards discarding and the LO

Member State Costs of Landing Obligation implementation

It is likely that implementation of the Landing Obligation will have cost implications for administration at Member State level. These costs could be associated with employing additional administrative, control and scientific staff who may be required to collect the necessary scientific, economic and social data, to monitor compliance or to manage and communicate the national approach to implementing the LO. There may also be additional costs associated with attending national and regional meetings. Changes in fleet structures or volumes of landings could also create changes to revenue streams which may fund national institutes. Increased use of observer or remote electronic monitoring may be a feature of monitoring LO implementation.

Although it may be difficult for national administrations to differentiate costs that are changed as a result of implementing the LO, nevertheless, information that might be useful to show the effects of the LO on administrative costs could include:

- Staff costs – additional salaries and expenses incurred above the level that would have been incurred had there not been a LO (Administrative, Control or Scientific staff)
- Other increased costs of control to detect and/or prevent discarding at sea
- Expanded programmes of observers at sea or remote electronic monitoring
- Legal costs relating to prosecutions for infringements and possibly defending cases brought by third parties e.g. relating to allocation of quota top up.
- Changes to funding sources and amounts of national institutes associated with LO implementation
- Use of EMFF to cover extra administration costs as a result of implementing the LO

Table 6.9 MS costs of implementing the LO.

• Staff Costs
• Additional Control Costs
• Expanded Observer/REM Programmes
• Legal Costs
• Funding sources and amounts
• Use EMFF funding to cover additional administration costs

The following collection of Tables suggests information to collect and present as indicators of LO impacts.

Table 6.10 Metrics and data that would be useful, with linking evidence, to show effects of the implementation of the LO. N.B. *indicates information is already collected and presented in the fleet or processing sector Annual Economic Reports or in the STECF balance report. **Bold type** indicates a particularly useful metric.

Metrics and measurements for Catching sector business impacts

Operational	Financial	Economic	Social

• **Fuel use ratios**
  ○ **per tonne landed***
  ○ per day at sea*
• Total days at sea per segment
• **Tonnes landed per day at sea***
• **Average trip duration**
• **Vessel use indicator***
• **Number of choke situations**
  ○ **Vessel level**
  ○ **PO level**
  ○ **MS level**
  ○ **EU level**
• **Ratio of anticipated chokes / observed choke situations**
• **Quota uptake***
• **Ratio of landings for human/non-human consumption**
	• **Sales prices per size grade of fish**
	• **Foregone Revenue due to change in size profile of landings**
	• Disposal costs for unsold fish
	• **Number of business failures attributed to choke situations**
	• **Total number of business failures**
	• **Value of fishing rights***
	• **Fish prices pre and post fleet level choke**
	• Total landings income*
	• Labour costs*
	• Fuel costs*
	  ○ Total*
	  ○ Additional due to LO
	• Repair costs*
	• **Estimated value of uncaught fish**
		• **Number of Vessels***
		• **Number of inactive vessels***
		• **Number of enterprises***
		• **Inactive fleet indicator***
		• Investments*
		• GVA*
		• **Operating (Gross) Profit***
		  ○ total per segment
		  ○ average per vessel
		• Fishing rights values
		• Fishing rights ownership/allocation
		• Use of EMFF for vessel or gear adjustments to comply with the LO
			• **Number of FTEs***
			• **Wages/Crew share***
			• **Average wages per FTE**
			• Working Hours*
			• Number and proportion of non-EEA crew
			• Incidence of non-compliant business practice.
			• Incidence of observer harassment
			• Weight of landings per crew member, by fleet segment.

Metrics and measurements for Upstream businesses impacts

Operational and Financial	Economic	Social
• **Value of sales by gear manufacturers** • **Number of improved selectivity fishing nets sold** • Value of sales of on-board technology • Value of sales by boat builders to fishing businesses • **Number of business failures, start-ups or expansions**	• Number of highly fishing dependent enterprises	• FTEs • Wages • Number of high-technology jobs

Metrics for Processing businesses reliant on landings by vessels subject to the LO

Operational	Financial	Economic	Social
• Volume of imported raw material to replace LO-caused foregone supplies • Volume of sales • Volume of raw material purchased for non-human consumption • **Business failures and start ups due to lack of raw material or availability of new raw material**	• **Value of purchased fish and raw material for production *** • **Turnover*** • **Total production costs*** • **Value of sales for non-human consumption**	• **Number of enterprises*** • GVA* • Strategic alliances eg. Processors engaging in gear selectivity trials or purchase of fishing rights • Net investments*	• **FTEs*** • **Wages***

Metrics and measurements relating to impacts in Consumption & Markets

• Consumption of different product sizes of fish in retail and foodservice
• Consumption of imported fish in retail and foodservice
• Incorporation of LO-related issues in environmental certification schemes
• Consumption of new products based on fish by-products
• Sales of non-human consumption products
• Sales of bait
• Public attitudes towards discarding and the LO

MS costs of implementing the LO

• Staff Costs
• Additional Control Costs
• Expanded Observer/REM Programmes
• Legal Costs
• Funding sources and amounts
• Use EMFF funding to cover additional administration costs

6.7 Long term environmental impacts

If the landing obligation is fully implemented it is likely that fishing operations will adjust towards more selective practices. The consequential reduction of unwanted catch discarded at sea (whether it is landed or not caught) is likely to affect the ecosystem megafauna and seabed communities, by changing species abundance and food availability.

Heath et al. (2014) showed that landing the entire catch of TAC-regulated species, while fishing as usual in the North Sea, has conservation penalties for seabirds, marine mammals, and seabed fauna, with no benefit to fish stocks. Fondo et al. (2015) concluded that to minimize the consequences of discards removal in marine ecosystems, a gradual reduction in fisheries discards to a minimal level should be considered. This minimal level would maintain the ecosystem's stability and allow species exploiting discards to habituate to the food subsidy reduction.

In this context, the already agreed MSFD descriptors to assess Good Environmental Status will be important to assess the long term impact of the LO, and of these, Descriptor 1 (biological diversity), Descriptor 4 (food webs) and Descriptor 6 (sea-floor integrity) will be particularly important (see Table 6.11). Amongst the criteria and related indicators associated with these descriptors some may prove more useful in the short term in demonstrating an impact of the LO

than others, as they include species and parameters that are more likely to be affected by the LO (for example scavengers and opportunistic feeders), have common aspects shared by the three different descriptors and are most readily operational. Examples from the indicators include the large fish indicator and condition of benthic community. In addition, other related indicators (Table 6.12) being discussed within the science community including biomass of trophic guilds and mean weights-at-age of predatory fish may also prove helpful in assessing the impact of LO.

MSFD descriptors, criteria and related indicators do not necessarily need to be analysed annually to detect long term impacts of the LO. They could be analysed less frequently, for example every 3 or 5 years. To enable this analysis however, the data stored, analysed and reported by MS to comply with the MSFD should be made available and reviewed with the specific objective of detecting LO impacts.

Table 6.11 MSFD descriptors, criteria and indicators considered useful in monitoring the landing obligation

MSFD Descriptor	Criteria and related Indicators	pros	cons
D1 Biological diversity is maintained	*Species level* (species and functional groups) Distribution Distributional range Distributional pattern Area covered by the species Population size Population abundance or biomass Population condition Population demographics (eg body size, survival rates etc) Population genetic structure	• available from DCF (surveys) • available from marine mammal + seabirds surveys • Includes benthic + megafauna species	• Species selection within functional groups may not reflect a change due to LO
	Habitat level Habitat condition Condition of typical species and Communities. Relative abundance and/or biomass		
	Ecosystem level Ecosystem structure Composition and relative proportions of ecosystem components		
D4 Food webs	Productivity of key species or groups Performance of key predator species Proportion of selected species at the top of food webs Proportion of large fish (eg LFI) Abundance/distribution of key trophic groups/species Abundance trends of functionally important selected groups/species	• May be available from various surveys • Available from DCF (surveys) • ICES working on it • MS report already • Includes commercial and non-commercial	Medium to long lag of the indicator response that would follow a change in fishing pressure (this may be true of a number of other indicators also)
D6 Sea-floor integrity	Condition benthic community(6.2) Presence of sensitive and/or tolerant species Multi-metric indices eg species diversity and richness, etc Prop. of macrobenthos above specific size Parameters describing size Spectrum of benthic community	• Applicable to scavenger species	• Additional data required? • Additional work required?

Table 6.12 Other indicators of potential value in monitoring the landing obligation

Additional Indicators	Pros	Cons
Biomass of trophic guilds	• partially from DCF (surveys) • marine mammal + seabirds surveys • Includes benthic + megafauna species	• Additional data required? • Additional work required
Seabird breeding success (food availability)	• Applicable to scavenger species • May be already available under D1	• Additional data required? • Additional work required?
Mean weights-at-age of predatory fish (food availability)	• Applicable to scavengers species	• Change in selectivity detected? (or change in fish abundance)
Mean length of surveyed community	• Available from DCF (surveys) • Includes juveniles • Includes commercial and non-commercial species	• Influence by recruitment • Change in selectivity detected?

Finally, it is likely that future scientific publications, for example presenting ecosystem modelling but not restricted to that topic, will possibly show changes that could be attributed or associated to the LO. A desk-study review of these papers could also illustrate long term impacts of the landing Obligation.

7 REPORTING TEMPLATES

7.1 Summary of reporting elements relating to items 1-7 in the Article (9) in the Omnibus

Tor 3 requests that EWG 16-04 "develops format (structure, content, data, etc.) for future reports by Member States that would support more in depth analysis and understanding of the impacts of the landing obligation". A proposed template for the elements included in Article 15(14) is provided in Annex 1 based on Section 5. Table 7.1 summarises the potential data sources and those best placed to report the data.

Table 7.1 Summary of the data sources and who is best placed to report on the elements included in Article 15(14).

Element	Data sources	Reported by
Steps taken to comply with the landing obligation	MS notices to industry EMFF reporting Scientific papers and RV cruise reports Advisory Council Reports PO reports (e.g.Industry info notices) Quota Management Plans/Notices Joint recommendations from MS Regional Groups	Member States (individually and regional groups) National scientific agencies Advisory Councils Producer Organisations
Steps taken regarding control of compliance with the landing obligation	Control authorities reports EFCA reports on JDP's	Control authorities Expert groups established by regional groups EFCA
Information on the socioeconomic impact of the LO	DCF (Annual Economic Report)	Member States
Information on the effect of the landing obligation on safety on board fishing vessels	Information from Advisory Councils Information from other industry Sources Incident reports from competent agencies EMFF reporting	Advisory Councils Producer Organisations etc. Coastguards, Health and Safety Ministries, Labour Inspectorates Control authorities Member States
Information on the use and outlets of catches below the minimum conservation reference size of a species subject to the landing obligation	Sales Notes and supporting sales information (e.g. transport and handling) Research reports on potential uses and destinations	Control authorities Producer Organisations and First Point of Sale Entities (e.g. Fishermen's Co-ops) National scientific agencies
Information on port infrastructures and of vessels' fitting with regard to the landing obligation for each fishery concerned	EMFF Reporting Industry information	Member States Advisory Councils
Information on the difficulties encountered in the implementation of the landing obligation and recommendations to address them	Information from Advisory Councils Information from Member States EFCA reports on JDPs	Advisory Councils Other industry sources Member States EFCA

7.2 Additional metrics and indicators not covered in Article 15(14)

Additional metrics and Indicators for monitoring Landing Obligation not covered by Article 15(14) are shown in Table 7.2. Note that the location of the text within the report is indicated in the first column

Table 7.2 Summary of additional indicators and metrics for monitoring impact of the LO

Subject area	Indicator/metric	Utility (and ref to any reservations)	Data availability	Estimated and provided by whom
Catch profiles 6.2	Compare observed catch compositions with reported catch compositions	To monitor whether reported data reflect what is observed at sea to provide (i) a short-term quality check on reported catch data and (ii) long-term trends and comparisons	From observer trips, last observed haul inspections, CCTV, and logbooks , resported landings, and market samples	Member state + others eg ECFA,
Catch profiles Section 6.2	Ratio of landings at age or length to research survey abundance at age or length	Gives an F at age proxy and can be used to investigate change in selection pattern over time.	Stocks for which survey abundances at age or length exist	MS -Landings at age data from (DCF). Comp to survey indices –ICES DATRAS (ICES areas) and/or STECF (JRC) MEDITS
Change in selectivity				
A. Gear selectivity (Section 6.4)	Uptake of new gears/shift in gears	To monitor the fleet response to the LO	Logbook	Member states
	Mesh size & configuration	To infer/monitor gear selectivity (if no other info)	Legislation, logbooks	Member states
	L50 (A50) and SR	To monitor gear selectivity	Gear selectivity trials, lit review	Member state, regional groups
	nP-, nP+ and nRatio (...)	To monitor the proportion of individuals retained in relation to MCRS	Gear selectivity curve, and population indices (e.g. from surveys, stock assessments)	expert groups (scientists)
B. Population selectivity Section 6.4	% of <MCRS in catch (by weight)	To monitor the proportion of undersized fraction in catch. Useful in the long-term. High sensitivity to population structure	DCF data, or stock assessments	Expert groups (e.g., stock assessment groups)
	Fbar of undersized age-classes	To monitor the fishing mortality of undersized fish. Somewhat sensitive to population structure in stocks with high recruitment variability	Stock assessment data (based on catch)	Expert groups (e.g., stock assessment groups)
	A50	To monitor the mean age at selection. Somewhat sensitive to population structure in stocks with high	Stock assessment data (based on catch)	Expert groups (e.g., stock assessment groups)

		recruitment variability		
	F<MCRS/F>MCRS (weighted by abundance)	To monitor relative fishing mortality of undersized fish. Independent of population structure.	Stock assessment data (based on catch)	Expert groups (e.g., stock assessment groups)
Spatial metrics Section 6.5	Distribution of fishing activities by depth (DFAD)			
	Proportion of fishing activities in critical areas			
Socioeconomic impacts Section 6.6	Extensive list of metrics outlined in Annex **			
Environmental impacts Section 6.7	MSFD criteria and indicators from Descriptors ***			
Compliance Section 6.3	Some potential future developments related to infringements etc			

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10 ANNEXES

10.1 Annex 1 Draft Reporting Template

Steps taken by Member States and producer organisations to comply with the landing obligation
Have you initiated, supported, participated in or implemented any measures and/or studies relating to the avoidance of unwanted catches through spatial or temporal changes to fishing behaviour (for example, studies/pilots on real time closures)? Yes/No Please specify the measures taken or studies. Which fleet segments/fisheries do these measures and/or studies apply to? What has the uptake of these measures and/or studies been in the fleet segments/fisheries to which they are applicable? Please provide the number and proportion of vessels in the segment/fishery.
Have you initiated any changes to your quota management system to implement the landing obligation? Yes/No Please specify these changes. *For stocks managed through catch limits, have you conducted a quantitative analysis to identify potential national choke issues? Yes/No* Please give details.
Have you pursued any exemptions to the landing obligation (either for high survival or de minimis) in the development of regional joint recommendations? Yes/No Please give details of each exemption pursued. What studies or evidence have you collected or produced in order to support such a request. What steps have you taken to ensure the amount discarded under granted de minimis exemptions does not exceed the permitted volume in the delegated act? What has been the utilisation of any granted de minimis exemptions in the fleet segment/fishery to which the exemption applies? Please provide the total weight and proportion of catch discarded under this exemption for each fleet segment/fishery to which an exemption applies. Have any of your vessels utilised the provision to discard fish which shows damage caused by predators? Yes/No Please provide the total weight of catch of each species discarded for each fleet segment/fishery concerned. For stocks managed by catch limits, did you make use of the provisions for inter-annual or inter-species flexibility? Yes/No Please identify which flexibility (or flexibilities) was used, and the corresponding reallocation of fishing opportunities for the stocks concerned.
In the development of joint recommendations, has consultation with Advisory Councils and other relevant stakeholders taken place? Yes/No Please outline the process of consultation with Advisory Councils. Please outline the process of consultation with other stakeholders, if relevant.

Following the adoption of the delegated act for a discard plan, have steps been taken to ensure adequate understanding among stakeholders of their obligations under the provisions of the act? Yes/No

Please outline the process of ensuring stakeholders understand the obligations that will apply to them.

Are there any other steps not covered by the questions above that you have carried out to effect compliance with the provisions of the landing obligation? Yes/No

Please specify the measures taken.

Which fleet segments/fisheries do these studies/pilots apply to?

What has the uptake been of these measures in the fleet segments/fisheries to which they are applicable? Please provide the number and proportion of vessels in the segment/fishery.

Steps taken by Member States regarding control of compliance with the landing obligation

Has information been provided by Member States administrations and control agencies to fishermen? Yes/no

In what format has this information taken:

- Initiatives directed to fishermen to improve compliance
- Guidelines on the application of the landing obligation, accurate recording of catches, etc.
- Other

Have guidelines been provided by Member States administrations and control agencies for inspectors? Yes/no

In what format has this information taken:

- Delivery of guidelines for inspectors on the effective and uniform application of the landing obligation.
- Seminars and trainings organised for presenting the guidelines to inspectors at national and regional level.

Have new control and monitoring tools been used by Member States? Yes/no

Please supply infomation on:

- Control tools used in the context of landing obligation, i.e. REM, traditional systems (aerial surveillance, inspections at sea), reference fleets, etc.
- Steps towards implementation of new tools, including electronic monitoring means dedicated to implementation of landing obligation, haul-by-haul recording, etc.

Have the Member state administrations and control authorities monitored below Minimum Conservation Reference Size (MCRS) catches at and after landing (traceability)? Yes/No

Please supply information on:

- initiatives taken to prevent under MCRS catches from reaching the commercial channels (pre-notification of landings of under MCRS catches, etc.).
- Measures taken to monitor landings at fish markets/auctions adopted.

Has control and monitoring been based on risk assessment? Yes/no

Please supply information on the risk assessment tools used and the results obtained, including those implemented by the regional Control Expert Groups in cooperation with EFCA.

Has the "last observed haul" approach elaborated by EFCA as a tool for monitoring the implementation of the landing obligation and to derive potential targets for inspection been used. Yes/No

Please give details of the fisheries covered and the extent of sampling.

Information on the socioeconomic impact of the landing obligation

Using the most appropriate indicators defined below, provide information on the socio-economics impacts on:

- The catching sector
- Upstream businesses
- Processors
- Consumption and markets
- Costs for Member States

Information on the effect of the landing obligation on safety on board fishing vessels

Have there been any reported incidents of overloading of vessels causing stability problems? Yes/No

Please specify the number and nature of such incidents.

Can you quantify these in terms of:

Number of deaths or serious injuries

No of vessels involved as a % of the specific fleet segment

Have there been any reported incidents of overloading of vessels forcing them to return to port early? Yes/No

Please specify the number and nature of such incidents.

Have there been any reported incidents or accidents on board vessels that can be attributable to excessive workload? Yes/No

Please specify the number and nature of such incidents or accidents.

Has any national legislation relating to safety on board fishing vessels arising from the landing obligation been amended or introduced? Yes/No

Please provide details of this legislation.

Have you provided or received any funding under Article 32 (Health and safety) of EMFF or Article 3 (Eligible operations on safety) and Article 6 (Eligible operations on working conditions) of Commission Delegated Regulation (EU) 2015/531 to mitigate against potential safety issues caused by the landing obligation? Yes/No

If yes, please specify the number of projects involved and the nature of the measures taken.

If no, have any measures been taken which have not been funded under the EMFF

Information on the use and outlets of catches below the minimum conservation reference size of a species subject to the landing obligation

What have been the main reported uses and destinations for catches below mcrs?

Can you quantify these catches by species in terms of volumes, price per tonne and associated costs for the different outlets such catches have been sent?

Have you carried out any studies or pilot projects considering the potential uses for such catches? Yes/No

Please provide details of such studies or pilot projects.

Information on port infrastructures and of vessels' fitting with regard to the landing obligation for each fishery concerned

Have you provided funding under Article 38 of the EMFF for modifications on board vessels for the handling of catches on board? Yes/No

Please specify the number, nature and total amount invested in such projects.

Have you provide funding under Article 43 of the EMFF for investment in the infrastructure of fishing ports, auction halls and shelters for the handling of unwanted catches? Yes/No

Please specify the number, nature and total amount invested in such projects.

Have you provide funding under Articles 68 and 69 of the EMFF for investment in marketing measures and the processing of fishery and aquaculture products? Yes/No

Please specify the number, nature and total amount invested in such projects.

Information on the difficulties encountered in the implementation of the landing obligation and recommendations to address them

Please provide information on the following:

<u>Operational difficulties, such as:</u>

- Avoidance and/or selectivity insufficient to avoid unwanted catches
- Handling, storage and processing of unwanted catches
- Lack of funding to adapt fishing gears, vessels or port infrastructure

<u>Difficulties relating to monitoring, control and enforcement, such as:</u>

- Lack of understanding or awareness of the rules
- Difficulties implementing and monitoring *de minimis* or high survivability exemptions

• Implementation problems with regard to control/monitoring processes or infrastructure (e.g. adaptation of ERS systems) • Refusal to carry observers
<u>Difficulties in fully utilising fishing opportunities, such as:</u> • Problems re-allocating quota to cover catches previously not landed • Problems with the timing or availability of quota swaps • Fisheries being forced to close early due to choke problems

10.2 Annex 2 Summary of the metrics and information that could potentially be used to show the impacts of the Landing Obligation on the different industry sectors

Metrics and measurements for impacts on the catching sector

Operational	Financial	Economic	Social

• **Fuel use ratios**
  ○ **per tonne landed***
  ○ per day at sea*
• Total days at sea per segment
• **Tonnes landed per day at sea***
• **Average trip duration**
• **Vessel use indicator***
• **Number of choke situations**
  ○ **Vessel level**
  ○ **PO level**
  ○ **MS level**
  ○ **EU level**
• **Ratio of anticipated chokes / observed choke situations**
• **Quota uptake***
• **Ratio of landings for human/non-human consumption**
	• **Sales prices per size grade of fish**
	• **Foregone Revenue due to change in size profile of landings**
	• Disposal costs for unsold fish
	• **Number of business failures attributed to choke situations**
	• **Total number of business failures**
	• **Value of fishing rights***
	• **Fish prices pre and post fleet level choke**
	• Total landings income*
	• Labour costs*
	• Fuel costs*
	  ○ Total*
	  ○ Additional due to LO
	• Repair costs*
	• **Estimated value of uncaught fish**
		• **Number of Vessels***
		• **Number of inactive vessels***
		• **Number of enterprises***
		• **Inactive fleet indicator***
		• Investments*
		• GVA*
		• **Operating (Gross) Profit***
		  ○ total per segment
		  ○ average per vessel
		• Fishing rights values
		• Fishing rights ownership/allocation
		• Use of EMFF for vessel or gear adjustments to comply with the LO
			• **Number of FTEs***
			• **Wages/Crew share***
			• **Average wages per FTE**
			• Working Hours*
			• Number and proportion of non-EEA crew
			• Incidence of non-compliant business practice.
			• Incidence of observer harassment
			• Weight of landings per crew member, by fleet segment.

Metrics and measurements for impacts on upstream businesses

Operational and Financial	Economic	Social
• **Value of sales by gear manufacturers** • **Number of improved selectivity fishing nets sold** • Value of sales of on-board technology • Value of sales by boat builders to fishing businesses • **Number of business failures, start-ups or expansions**	• Number of highly fishing dependent enterprises	• FTEs • Wages • Number of high-technology jobs

Metrics and measurements for impacts on processing businesses reliant on landings by vessels subject to the Landing Obligation

Operational	Financial	Economic	Social
• Volume of imported raw material to replace LO-caused foregone supplies • Volume of sales • Volume of raw material purchased for non-human consumption • **Business failures and start ups due to lack of raw material or availability of new raw material**	• **Value of purchased fish and raw material for production *** • **Turnover*** • **Total production costs*** • **Value of sales for non-human consumption**	• **Number of enterprises*** • GVA* • Strategic alliances eg. Processors engaging in gear selectivity trials or purchase of fishing rights • Net investments*	• **FTEs*** • **Wages***

Metrics and measurements for impacts on consumption & markets

- Consumption of different product sizes of fish in retail and foodservice
- Consumption of imported fish in retail and foodservice
- Incorporation of LO-related issues in environmental certification schemes
- Consumption of new products based on fish by-products
- Sales of non-human consumption products
- Sales of bait
- Public attitudes towards discarding and the LO

Costs to Member States for the implementation of the Landing Obligation

- Staff Costs
- Additional Control Costs
- Expanded Observer/REM Programmes
- Legal Costs
- Funding sources and amounts
- Use EMFF funding to cover additional administration costs

11 LIST OF BACKGROUND DOCUMENTS

Background documents are published on the meeting's web site on:
https://stecf.jrc.ec.europa.eu/ewg1604

European Commission

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Ulrich, C.., Abella, J. A., Andersen, J., Arrizabalaga, H., Bailey, N., Bertignac, M., Borges, L., Cardinale, M., Catchpole, T., Curtis, H., Daskalov, G., Döring, R., Gascuel, D., Knittweis, L., Malvarosa, L., Martin, P., Motova, A., Murua, H., Nord, J., Pastoors, M., Paulrud, A., Prellezo, R., Raid, T., Sabatella, E., Sala, A., Scarcella, G., Soldo, A., Somarakis, S., Stransky, C., van Hoof, L., Vanhee, W., Vrgoc, Nedo.

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